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DEPARTMENT OF NORTHERN AFFAIRS AND
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Bulletin No. 132

ANNUAL REPORT OF THE

NATIONAL MUSEUM OF CANADA

FOR THE FISCAL YEAR 1952-53

1954

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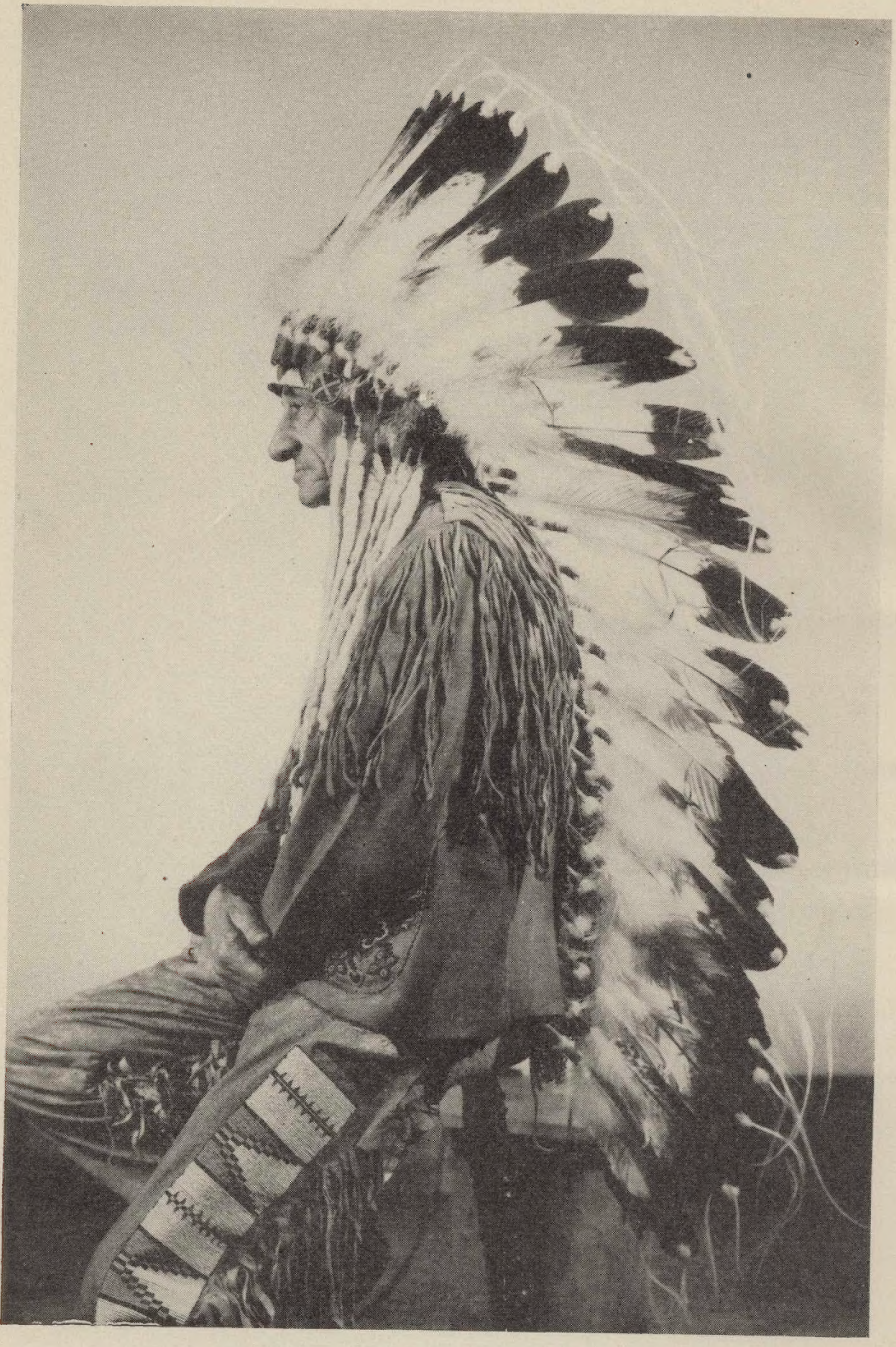

Indian head-dress (Plains)

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GENERAL ACTIVITIES OF THE NATIONAL MUSEUM OF CANADA

By F. J. Alcock, Chief Curator

During the fiscal year 1952–53 field investigations were carried out in various parts of Canada and specimens were collected; research projects were continued and others initiated; reports were prepared and issued on various phases of the Museum's activities; exhibits were improved and enlarged, and the educational program was continued. Fourteen members of the Museum's staff did field work during the summer season, and nine other workers performed field investigations through funds provided in whole or in part by the Museum. Archæological studies were made in Quebec, Ontario, Saskatchewan, Manitoba, British Columbia, and the Northwest Territories. A special anthropological investigation involving a study of the blood-grouping factors among the Indians of southern Alberta was begun. Folklore and folk-song studies were made in Quebec, New Brunswick, Nova Scotia, and Newfoundland. Field work in botany was carried out in Nova Scotia and northern Ontario. The birds of Prince Edward Island and the mammals of Gaspé Peninsula, Anticosti Island, and the Magdalen Islands of the Province of Quebec were studied. Zoological investigations were made on Prince Patrick Island of the western Arctic. Further field studies were conducted in the Cypress Hills of southwestern Saskatchewan for fossil mammals, and other palæontological investigations were carried out in the Flathead Valley of southeastern British Columbia.

Exhibits of birds in the Habitat and Bird Hall and of the mammals in the Mammal Hall to the west of the Rotunda were renovated. A large mural of a group of Titanotheres, painted by P. R. Haldorsen, was added to the Hall of Fossil Vertebrates on the ground floor, and a British Columbia Indian fishing scene, painted by A. E. Ingram, was placed in the west Anthropological Hall. Better lighting was provided for the mineral exhibit on the second floor. A mass of quartz crystals weighing about 1,500 pounds, presented by J. B. Steele, Superintendent of the Quartz Crystal Mining Corporation, Lyndhurst, Ontario, was placed on exhibition. The policy of having a special "Exhibit of the Month" in the rotunda was continued.

A series of Wednesday evening illustrated lectures for adults, beginning in late October and continuing until March, proved very popular. During the same period Saturday morning lectures for children were also given. The Auditorium was also used for lectures by scientific societies on numerous occasions throughout the year. The Macoun Field Club, an organization sponsored by the National Museum and the Ottawa Field-Naturalists Club, had a very successful year, the fifth since it was begun. Its object is to stimulate interest and give training to boys and girls in various phases of natural history.

During the period covered by this report the following Museum Bulletins were issued and made available for distribution: *Iroquois Pottery Types*, Bulletin No. 124, a technique for the study of Iroquois prehistory, 166 pages, by Richard S. MacNeish; *Birds of the West James Bay and Southern Hudson Bay Coasts*, Bulletin No. 125, 114 pages, by T. H. Manning; *Annual Report of the National Museum of Canada for the Fiscal Year 1950–51*, Bulletin No. 126, 227 pages. A report of eleven pages prepared by Austin W. Cameron was issued under the title *Hints on the Control of Small Mammal Pests in Eastern Canada*. An index of the *Publications of the National Museum of Canada 1913–1951*, 127 pages, was also made available. This index lists the publications in numerical order and also by author, by subject, and by region.

During the year the Museum had many visitors, including a large number of scientists who wished to consult members of the technical staff. Conducted tours for groups of adults and children continued as an important phase of the educational program. Material was loaned for a number of important exhibits both in Canada and abroad.

The Chief Curator visited the Summer School of Indian Archæology sponsored by the University of Western Ontario held at Penetanguishene, July 2 to July 16, and addressed the school on the subject *The National Museum and Canadian Archæology*. He also attended in August the meetings at Washington of the International Geographical Union. Miss M. W. Godwin, Assistant in Education, represented Canada at the UNESCO Seminar on *The Role of the Museum in Education*, held at Brooklyn, N.Y., in September and October, to which twenty-five countries sent participants. At the annual meeting of the Canadian Museums Association held at Toronto in October, the National Museum was represented by Miss V. M. Humphreys, Miss M. W. Godwin, E. L. Bousfield, L. S. Russell, and the Chief Curator. At the centenary celebrations of Laval University held at Quebec City, June 19 to 21, the Museum was represented by Dr. Marius Barbeau, a former member of the Museum's staff, who is still actively associated with the Museum. On this occasion Dr. Barbeau received the honorary degree of Doctor of Letters.

Educational Services

Museum educational activity was concerned with the interpretation of the museum collections to the public by various media. By means of correspondence, publications, and visual aids, accurate and specialized knowledge on anthropology, biology, and other phases of the natural history of Canada was brought to many who could not otherwise obtain it.

Many thousands visited the exhibits, which are labelled in non-technical language, and, in addition, many junior and senior school pupils came in organized study groups. The total number of those who visited the exhibition halls during the year, as well as those who took part in museum activities, was 216,824.

National Museum Lectures

The series of popular educational lectures and motion picture programs organized by the National Museum was most successful. This series, which has been carried on for more than thirty years, presents, in addition to lectures and motion pictures on natural history and related subjects, those on up-to-date topics of general concern. The subjects given on the series were:

Adult Lectures

Mount McKinley—1951, by Bradford Washburn, Boston, Mass., U.S.A.
Our Universe as We Know It Today, by C. S. Beals, Ph.D., F.R.S.C., Ottawa.
Around the Hawaiian Islands, by Yew Char, Honolulu, Hawaii.
Are You Going to Build? by Robert F. Legget, M. Eng., M.E.I.C., Ottawa.
Scenic Ontario, by J. M. Humphrey, Vancouver, B.C.
A Motion Picture—*Nanook of the North,* with introduction by Douglas Leechman, Ph.D., Ottawa (Repeated by request).
Motion Picture Program—*Commonwealth of Nations,* with introduction by A. Gordon Huson, B.Sc. (Econ.), Ottawa.
Mountains and Deserts of Algeria, by J. M. Harrison, Ph.D., Ottawa.
Listening to Nature, by William W. H. Gunn, Ph.D., Ottawa.
Historic Canada, by C. G. Childe, Ottawa.
The Romance of Glass, by James V. Mathews, Corning, N.Y., U.S.A.
Canoeing in the Western Arctic, by T. H. Manning, Ottawa.
The Atlantic Salmon, by Percy C. Nobbs, M.A. (Edin.), F.R.I.B.A., R.C.A., Montreal.
Holland Carries On, by Mari J. van Schreven, Ottawa.

Children's Lectures

Motion Picture Program—*Bush Christmas.*
A Live Program—directed by W. E. Steele, Kemptville, Ont.
Birds as a Hobby—by W. E. Godfrey, B.Sc., Ottawa.
The Royal Tour, 1951, by Mrs. R. H. Winters, Ottawa.
Motion Picture Program—*The Enchanted Forest.*
Across the Sahara Desert, by J. M. Harrison, Ph.D., Ottawa.
Horses, Horses, Horses, by L. S. Russell, Ph.D., Ottawa.
Three Big Bruins, by R. D. Harris, B.A., Ottawa.
Motion Picture Program—*Nanook of the North,* with introduction by Douglas Leechman, Ph.D., Ottawa.
Airplanes and Helicopters in Canada's Northland, by C. S. Lord, Ph.D., Ottawa.
Motion Picture Program—*Realm of the Wild, Alive in the Deep.*
Adventures in the Arctic, by S. D. MacDonald, Ottawa.
Children of Other Lands—Holland, in co-operation with the Citizens Committee on Children and the staff of the Netherlands Embassy.

Group Visits

School groups, in numbers greater than during previous years, visited the Museum with their teachers for guidance and instruction to supplement their school studies. Certain groups came for regular study and enjoyed the unusual experience of school work outside the classroom. In addition to students from Ottawa and vicinity, classes came also from Hamilton, Kitchener, Owen Sound, Meaford, North Bay, and Kingston, and Girl Guide groups came from all parts of Canada. An advanced group of young men from the United Kingdom and an international group of New Canadians were given guided tours of the exhibition halls.

Lecture Hall

The use of the lecture hall was granted, as in former years, to scientific and related organizations, and the public was thus given the opportunity of hearing significant lectures on a variety of subjects. Among the organizations that used the hall were the Royal Astronomical Society, Ottawa

Aeronautical Society, Scientific Film Society, National Gallery, United Nations Association, Ottawa Fish and Game Association, Logan Geological Club, and Canadian Geographical Society.

Photographs

Photographs on anthropological, biological, and palæontological subjects from the Museum collections were supplied for illustrations in scientific text books and in magazine and newspaper articles, and for use in the study of natural history subjects in schools. Requests were received from all parts of Canada, from European countries, and from South America, the United Kingdom, and the United States.

Visual Aids

Visual aids on anthropology, biology, palæontology, and other phases of natural history were lent to museums, teachers, and other persons in all parts of Canada. This material is sent out on restricted loan, free of charge, except for payment of transportation one way.

ARCHÆOLOGY

Field Work

Douglas Leechman was in the field from the middle of May to the early part of September. He made a study of pictographs in the Calgary area and also in the vicinity of Penticton, British Columbia, where he recorded several new sites and took photographs in colour.

In Vancouver Dr. Leechman examined specimens of a new stone culture discovered in the Kitimat area. He investigated archæological sites in the Okanagan Valley, visited local collectors, and studied their specimens and discussed their problems with them. He visited an important site at Hope, B.C., and others at Penticton, Kelowna, Vernon, and Salmon Arm. Near Vernon, a small lake showed two cultures of different ages on opposite sides, and the site was noted for more detailed examination in the future. He then went up the valley of the North Thompson River and spent some time on a site at Dutch Lake, near Clearwater, B.C., where two good sites were found and a number of specimens collected. Three small sites in the vicinity of Jasper, Alta., were examined, as well as sites and collections at Edmonton, Red Deer, and Calgary. A series of Indian burials having been reported from Point Pelee, he went down to Leamington, Ontario, and excavated two of them. A visit was made to Chaffey's Locks, Ontario, to study a collection of Indian and other artifacts.

Richard S. MacNeish excavated three sites near Fort Liard in the Northwest Territories and surveyed and dug two others at the west end of Great Bear Lake. Both of these areas are of considerable importance and will probably throw light on the early movements of man into North America.

Dr. MacNeish worked at two points in Manitoba and excavated an Early Man site near Gilbert Plains and a more recent one near Brandon. In January, 1953, during his annual leave, he made an archæological survey of a series of cave sites in southern Tamaulipas, Mexico, on behalf of the Department of Botany, Harvard University.

Thomas E. Lee conducted a large scale dig at the Sheguiandah site on Manitoulin Island, where an ancient quarry and workshop had been discovered by him on a previous field expedition. Twenty or more assistants were employed and several thousands of specimens collected. Other sites in Ontario and Quebec were investigated and collections made.

Mr. Lee also made detailed investigations in the vicinity of Hawkesbury, in an effort to determine the precise location of the famous Dollard incident. Many claims were investigated and a general survey of the area was conducted. Excavation at a probable site revealed traces of an old palisade and other archæological material.

Mr. Boyd Wettlaufer continued investigations that he had begun in 1951. He visited sites in Saskatchewan and Manitoba where Indian artifacts had been found and obtained information about such material and photographed local collections of them. He also carried out excavation on a number of sites.

Office Work

Douglas Leechman wrote a paper on the Vanta Kutchin, a band of the Loucheux of northwestern Canada; a paper on the present condition of Indian handicrafts; and another on the Eskimo for inclusion in a bulletin of the Northwest Territories. He worked on a paper on the pictographs of southwestern Alberta, which is now ready for publication, and prepared shorter notes and memoranda on a number of subjects.

He edited a long manuscript on the Folklore of Waterloo County, which is an addition to the Bulletin on that subject already published by the Museum; edited a report on the field work conducted by Dr. C. McClellan for the Museum; criticized a book-length manuscript on the Dorset culture of Newfoundland by Dr. Elmer Harp.

He attended sessions of the Panel on Indian Affairs and also of a special Eskimo Affairs Panel. He read a paper at the Conference of Northeast Museums in Newark, New Jersey, October 23 to 25, at which meeting he was elected President of the Northeast Museums Association for the coming year, and attended the convention of the American Anthropological Association in Philadelphia from December 27 to 30 and the Dominion-Provincial Tourist Conference in Ottawa from December 1 to 3, 1952. He worked with the Canadian Board on Geographical Names and attended sessions of a special committee on names for the French edition of a new map of Canada. He compiled a table showing the Indian population of Canada arranged by linguistic stocks, and another showing the tribal affiliation of the residents on each of the reservations in Canada. He started work on a new map of Canada showing the location of Indian tribes and their linguistic stocks.

Dr. Leechman wrote script for a film strip on Totem Poles and produced it in collaboration with the National Film Board. He also prepared a list of headings and cross-references for the photographic collection in the library which now contains many thousands of prints. He also studied the material he collected in the field and collated his results with previous field investigations.

Dr. MacNeish analysed the material collected from the sites he excavated both during this field season and on previous occasions. This study revealed a sequence, extending from about 3,000 years ago to historic times, of four separate cultures in the vicinity of Winnipeg. He also studied specimens collected in the Northwest Territories and prepared technical reports on these materials.

He visited the Division of Anthropology at the University of British Columbia, at their request, and discussed archæological problems in that province. He also attended sessions of the Society for American Archæology at Philadelphia in December, 1952. He consulted with Dr. F. Johnson and Dr. Elmer Harp concerning archæological problems connected with work they are undertaking in Canada.

Mr. Lee studied the materials collected in the course of his field work, catalogued them, and listed and titled his field photographs. He prepared lantern slides and notes for public lectures, and reports for publication, including most of a long and detailed report on the site at Sheguiandah, and also reports on an archæological survey and further investigations of the palisade site near Hawkesbury.

Publications

"Unused" Hammerstones, by Douglas Leechman. American Antiquity, January, 1953.

The Nanaimo Petroglyph, by Douglas Leechman. Canadian Geographical Journal, June, 1952.

The Prairie Indian Tipi, by Douglas Leechman. Canadian Geographical Journal, September, 1952.

The Blackfoot, by Douglas Leechman. The Beaver, September, 1952.

The Swampy Cree, by Douglas Leechman. The Beaver, December, 1952.

The Chilkat Blanket, by Douglas Leechman. Canadian Geographical Journal, February, 1953.

Iroquois Pottery Types, by R. S. MacNeish. National Museum of Canada, Bulletin 124, Ottawa, 1952.

A Possible Early Site in the Thunder Bay District, by R. S. MacNeish. National Museum of Canada, Bulletin 126, Ottawa, 1952.

Archæology of the Northeastern United States, by R. S. MacNeish. *In* Archæology of the Eastern United States. University of Chicago Press, Chicago, 1952.

Kincaid, a Prehistoric Illinois Metropolis, by R. S. MacNeish (co-author). University of Chicago Press, Chicago, 1951.

Lectures

By Douglas Leechman:

- *Eskimo Art.* Arts and Crafts Club, Brockville, Ontario, April 10, 1952.
- *Archæology in Alberta.* Radio Station CFAC, Calgary. September 9, 1952.
- *Canada's Last Frontier—the Yukon.* Association of Canadian Clubs in British Columbia, September 12 to October 2, 1952.
- *How to Present a Film Program.* Northeast Museums Conference, Newark, N.J., October 24, 1952.
- *Nanook of the North.* National Museum of Canada, Ottawa. December 3, 1952, February 28, and March 11, 1953.
- *The Indians of the Ottawa Valley.* Women's University Club, Ottawa. January 19, 1953.
- *Photographing the Yukon.* Geodetic Society, Ottawa. March 20, 1953.

By R. S. MacNeish:

- *Human Origins.* Carleton College, Ottawa. April, 1952.
- *Archæology Needs You.* High School, Gilbert Plains, Manitoba. September 27, 1952.
- *Anthropology in the World Today.* Brandon College, Manitoba. October 5, 1952.
- *Early Man in America.* Department of Anthropology, University of British Columbia, November 8, 1952.
- *Archæology of the Interior of Canada.* Class in Archæology, University of British Columbia, November 8, 1952.
- *Archæological Significance of Central Canada.* Symposium on New World Archæology. American Anthropological Association, Philadelphia, December 28, 1952.

BY THOMAS E. LEE:

Discovery and Exploration of the Sheguiandah Site, Manitoulin Island. Rotary Club, Aylmer, Ontario, November 7, 1952. Also at Ontario Archæological Society, Toronto, November 13, 1952; Field-Naturalists' Club, Toronto, January 5, 1953; and Macoun Field Naturalists' Club, January 27, 1953.

Accessions

Col. G. L. Jennings: Indian and Eskimo materials from the Northwest Territories.

Mrs. Joachim Jobin: Early French-Canadian clothing from Quebec.

Thomas E. Lee: archæological material from Manitoulin Island and southern Ontario.

Dr. Douglas Leechman: archæological material from British Columbia and Alberta.

Mrs. Beverly MacDonald: Assomption sash from Quebec.

Dr. R. S. MacNeish: archæological material from the Northwest Territories and Manitoba.

Col. C. P. Meredith: copper blade and chipped stone points from Ontario.

Jean Palardy: French-Canadian pottery from Quebec.

Dr. H. A. Quinn: chipped stone blades from Keewatin.

M. L. Rush: copper awl, celt, and chipped blade from Ontario.

Miss Erica Selfridge: chipped stone points from Margaretsville, N.S.

Dr. G. H. Turner: chipped stone implement from Fort Saskatchewan, Alta.

J. A. Wilson: Indian beadwork from the Prairies.

ETHNOLOGY

Field Work

Marcel Rioux spent the summer of 1952 in Gaspé Peninsula in order to collect and systematize anthropological and folklore materials for a collective Museum publication on that region; this study will include mainly materials on the cultural anthropology, geography, and folklore of Gaspé. An intensive study of a Gaspesian fishing community was undertaken with a view to writing a monograph on that village to illustrate some of the sociocultural aspects of this region; many other villages were visited so as to gain as complete a picture as possible of all the ethnic groups of the Peninsula. The study of l'Anse-aux-Gascons, the village chosen for investigation, will not only serve the purpose outlined above, but will also be of use for the inquiry into the urbanization processes and cultural dynamics of French Canada, a study undertaken some years ago, of which the forthcoming publication by the Museum of a monograph on Ile Verte is the first step.

Miss Carmen Roy worked from June to December, in conjunction with Mr. Rioux, on her materials on the folklore of Gaspé; she aimed at completing her investigations which were initiated some years ago. Progress was made in that direction. Her report will present not only specimens of the oral literature of this region but also the actual distribution of the phenomena under study.

From June to December, Miss Helen Creighton continued to collect folklore materials in Nova Scotia and New Brunswick; as in the past years, her findings were numerous and of good quality.

Kenneth H. Peacock spent two months in the Province of Newfoundland collecting folk songs of this region. During the three summers in which the Museum has sent a folklorist to Newfoundland, excellent collections were made, and the knowledge of the traditional oral literature of this province has been greatly increased.

Luc Lacourcière and Miss Madeleine Doyon of Laval University continued to work in New Brunswick and in Beauce County (Quebec), respectively.

Office Work

In the office, Marcel Rioux completed for publication his monograph on Ile Verte, a small French-Canadian community which he investigated in 1948. He analysed the printed sources on Gaspé in order to prepare a monograph on that region, and prepared for publication two articles, one based on the materials collected at Gascons: *Sociability and Social Typology* and the other on *Anthropology and Social Psychology*. The Canadian section of the Werner-Gren Foundation for Anthropological Research publication on *World Resources for Research and Education in Anthropology* was also revised and completed by him. In the course of the year, Mr. Rioux was appointed Visiting Fellow of *Le Centre de Recherches en Relations Humaines* of Montreal, and Research Director of *The Centre for Research in Amerindian Anthropology* of the University of Ottawa.

After terminating their field work, Mr. Peacock and Misses Creighton and Roy worked on their materials, classifying and systematizing their data.

Publications

Canadian Section of *World Resources for Research and Education in Anthropology*, by Marcel Rioux. Werner-Gren Foundation for Anthropological Research, New York. 1953. 25 pp.

Relations between Religion and Government Among the Longhouse Iroquois of Grand River, Ontario, by Marcel Rioux. Bulletin 126, Annual Report, National Museum of Canada for the Fiscal Year 1950-51. pp. 94-98.

Lectures

De la liberté comme condition essentielle de l'étude des sciences sociales, by Marcel Rioux. C.B.C. December 9, 1952.

Humanité ou Sciences, by Marcel Rioux. C.B.C.

Forum on Education, by Marcel Rioux. March 20, 1953.

ZOOLOGY

Field Work

A survey of the summer bird life of Prince Edward Island was carried out by W. Earl Godfrey, assisted by John A. Crosby. Emphasis was on the species composition, local distribution, numerical status, and taxonomy. This survey was unusually prolific in information, amply confirming the earlier suspicion that previous works on the birds of this area are quite inadequate. In addition, a considerable amount of information on the spring, autumn, and winter status of Prince Edward Island birds was obtained through interviews with several local amateur ornithologists, provincial government officials, and through examination of the bird collection in the Prince of Wales College. Some observations were also made on mammals. En route from Prince Edward Island to Ottawa the famous gannet colony of Bonaventure Island, Quebec, was visited. Coloured motion pictures were taken of these birds, and notes were made on their behaviour. Distributional notes on other birds occurring there were also secured. Considerable information on this colony was made available for our files by Warden Willie Duval, who has had a lifetime of experience in the area.

Field studies were made by Austin W. Cameron on the mammals of Anticosti Island, the Cascapedia area of the Gaspé Peninsula, and the Magdalen Islands. Highlight of the results was the collecting of two complete specimens of the grey seal, the first skins of this rare species to be added to the Museum's collection. A large concentration of this species was located on the west end of Anticosti Island, and a considerable volume of information on it was secured. Twenty-one specimens of the race of the white-footed mouse, peculiar to Anticosti Island, were obtained—the first specimens to be added to the Museum's collection and the only specimens possessed by any museum except the Cleveland Museum of Natural History. In addition to the skins of mammals, a collection was made of specimens in formalin solution for anatomical study.

Field work by S. D. MacDonald consisted of a biological investigation of the Mould Bay area, Prince Patrick Island, N.W.T. About six months were spent in the field. This was a continuation of the work begun here in 1949; at that time the main effort was on the birds and mammals. This season other groups were given priority, although one species was added to the list of birds and supplementary collections of birds and mammals were made. The emphasis was placed on the collecting of marine and freshwater invertebrates, and endo- and ecto-parasites. When time permitted, vascular plants, lichens, and fossils were also collected. The marine collecting was seriously handicapped by ice and adverse wind conditions and, most of all, by lack of a boat large enough to permit dredging at times other than in a complete calm. In spite of this, 60 lots of marine invertebrates and fishes were taken. Detailed wildlife notes were made and water-colour sketches and line drawings were prepared. Careful observations on the numerical status of all species were recorded daily. Early in September an accident forced MacDonald to return to Ottawa for medical treatment, thus shortening the planned field season by three weeks.

L. S. Russell spent two months in southeastern British Columbia in a palæontological exploration of the Kishenehn formation along the North Branch of Flathead River. This was a continuation of the work begun here in 1950. Russell was assisted by Colin L. Thacker, who also acted as zoological collector and made a representative collection of recent birds and mammals. During the palæontological work all outcrops of the Kishenehn formation were examined, from the most southerly in northern Montana to as far north in British Columbia as the road had been opened. Important additions were made to the known fauna of freshwater molluscs, and an entirely new fauna of terrestrial gastropods was obtained. At three different localities, identifiable teeth and bones of small mammals were discovered; these will permit a more definite dating of the formation and give a precise age significance to the molluscan fauna. It is hoped to continue this work in order to obtain an adequate collection of these fossils, which are important in themselves and also may assist greatly in the working out of the Tertiary history of British Columbia. After leaving Flathead, Russell examined certain localities near Cranbrook and Fernie, where future field work might be carried out.

G. E. Lindblad, assisted by H. L. Shearman and Michael Herniak, conducted a fossil-collecting expedition to the Oligocene deposits of the Cypress Hills, Saskatchewan. This was a continuation of the work of Russell in 1951. The excavation of the Hunter quarry was extended northward, and additional skulls and bones of titanotheres were obtained, as well as a skull of the rare "giant pig" (*Archaeotherium*). About 1,300 pounds of fossils in rock were shipped to Ottawa. At the close of the field season Lindblad remained in Eastend for about ten days to repair the skull of the dinosaur *Triceratops* in the local museum, which was badly damaged by a flood in April.

Office Work

L. S. Russell continued to supervise the general administration of the zoology section. His principal research work during the year consisted of the preparation and study of the fossil molluscs and mammals obtained during the field season from the Kishenehn formation of southeastern British Columbia. Some work was also done on the Oligocene mammals of the Cypress Hills, Saskatchewan. Papers on a eurypterid and on the ostracoderm *Cephalaspis* from the Devonian of Gaspé were completed. Various lots of specimens of fossil vertebrates and fossil and recent molluscs were examined for Robert Cochrane, Grande Prairie, Alta; the Provincial Museum, Regina, Sask.; the Geological Survey of Canada, Ottawa; the Royal Ontario Museum of Zoology and Palæontology, Toronto, Ont.; and the Dominion Parasite Laboratory, Belleville, Ont. The reference collection of fossil vertebrates was under revision, involving not only rearranging and relabelling but also some identifying. The work of the laboratory of vertebrate palæontology was generally supervised. Dr. Russell was Secretary-Treasurer and Editor of the Canadian Museums Association during the year.

W. Earl Godfrey brought to near-completion a comprehensive account of the birds of Prince Edward Island; this is based on the Museum expedition of 1952, but included in it are many data hitherto unpublished from the records of other workers. All known published data on the birds of this region have been carefully appraised. Mr. Godfrey also completed the manuscript of an article entitled *Birds of the Canadian Arctic*, a 33-page annotated list of birds that regularly occur in this region, which gives Arctic ranges and methods of recognizing each species in the field. Earlier in the year Godfrey prepared a paper on the birds of Ellesmere Island, which he submitted for publication. He wrote numerous reviews of the ornithological literature and submitted them to journals. He also performed the duties of special editor for *The Canadian Field-Naturalist* and *Bird Banding*. The complete rearrangement of the study collection of Canadian birds was carried out under Godfrey's direction by J. Mitchell Campbell. In addition to a large number of inquiries concerning birds, specimens or collections were examined for a number of persons and institutions, including A. E. Bourguignon, Ottawa; Leslie M. Tuck, Canadian Wildlife Service, St. John's, Nfld.; Hoyes Lloyd, Ottawa, Ont.; G. G. Ommaney, Hudson Heights, Que.; Alva Morrison, Boston, Mass.; Dr. Herbert Brandt, Cleveland, Ohio; Samuel Waller, The Pas, Man.; Rev. René Tanguay, Kamouraska, Que.; Dr. George Stirrett, Canadian Wildlife Service, Kingston, Ont.; Dr. Brina Kessel, University of Alaska; R. W.

Tufts, Wolfville, N.S.; A. L. Wilk, Camrose, Alta. In the renovation of the systematic bird exhibit, Godfrey laid out the order of arrangement and wrote the text for the new labels.

Austin W. Cameron completed early in the year a manuscript entitled *The Mammals of Southeastern Quebec*, for publication by the Provancher Society of Natural History. On returning from the field, he compiled a complete bibliography, covering such details as taxonomy, distribution, numerical status, economic status, and data from early explorers, of publications dealing with the mammals of Newfoundland, Anticosti, and the Magdalens. Also included was a bibliography of papers dealing with the mammals of comparable groups of islands. This is to assist in the preparation of a study on the mammals of the islands in the Gulf of St. Lawrence. A statistical analysis, to be used in a forthcoming report, was completed of the range of variation in the cranial characters of muskrat and beaver from Newfoundland and continental Canada. A manuscript, with illustrations, entitled *Mammals of the Canadian Arctic Tundra*, was prepared for publication by the Department. A number of reviews of literature in mammalogy were prepared and submitted for publication in journals. Mammal specimens were examined for Dr. R. S. MacNeish, National Museum; C. C. Loan, Department of Entomology, University of Minnesota; J. E. H. Martin, Biological Control Laboratory, Department of Agriculture; D. H. Pimlott, Department of Natural Resources, Newfoundland. Curatorial work on the mammal collection included the incorporation of new material and its replacement in the collection of specimens returned from loans. On December 13, Cameron went on leave of absence to continue his graduate studies at the Department of Zoology, McGill University.

E. L. Bousfield returned from leave of absence at Harvard University on July 2. He remained in the office during the summer to continue work on a paper—*Ecological Relations of Barnacles in the Miramichi Estuary and Atlantic Coast of Canada*. Several short articles and reviews of literature were also prepared. Some editorial work was done for the National Museum publications and the *Canadian Field-Naturalist*. Collections of recent invertebrates were identified for H. G. Crawford, Department of Agriculture, Ottawa; Dr. B. Hocking, University of Alberta; Dr. G. MacDonald, Apple Hill, Ont. Curatorial work on the invertebrate collection included the renovation of material from the Canadian Arctic Expedition and the incorporation of a large series from the Fisheries Research Board of Canada. Bousfield began the organization of a museum exhibit of east and west coast Canadian crustaceans. Some guidance on natural history subjects was given to the Macoun Field Club.

John Sherman Bleakney joined the zoology section on October 1 as curator of ichthyology and herpetology. He continued his research on the amphibians and reptiles of Eastern Canada, a study that involves the taxonomy, distribution, ecological relationships, life histories, and methods of preservation. A number of distributional maps for the amphibians and reptiles of this region were completed. A manuscript on *The Four-toed Salamander in Nova Scotia* and several book reviews were submitted for publication. Considerable time was spent organizing the notes and photographs left by the late C. L. Patch. Some editorial work was done for the National Museum publications and the *Canadian Field-Naturalist*.

The museum exhibit of amphibians and reptiles was completely revised and new labels inserted. A large series of amphibians and reptiles was catalogued; this included the material collected by Bleakney during the field season of 1952, under a grant from the Arctic Institute of North America.

John A. Crosby, the zoological artist, completed early in the year the renovation of the systematic mammal exhibit, and later was responsible for the placing and labelling of specimens in the systematic bird exhibit. About 400 temporary labels were printed by hand. He prepared a series of scale models in the half-round, illustrating the more important whales of Canadian waters. He made a series of bird paintings for use in a film strip. In the preparation of a small guide to the exhibits of the National Museum, Crosby set the type and made seven illustrations. He also prepared a number of illustrations for papers by other members of the zoology section. Experiments in the use of the new media for museum exhibits were carried out. His design for a stamp, showing the polar bear, was accepted for reproduction by the Canada Post Office.

G. E. Lindblad continued the detailed supervision of the work in the laboratory of vertebrate palæontology. He has prepared for mounting and exhibition the skeleton of the primitive reptile *Champsosaurus*. Considerable time was spent in locating sources of the special equipment and materials required for laboratory and field work in vertebrate palæontology. Lindblad made several visits to the Royal Ontario Museum to obtain information on methods and on specimens similar to the one on which he was working.

S. D. MacDonald worked on the report of his zoological investigation at Mould Bay. He supervised the zoological preparation and prepared a number of specimens for study or exhibition. In the renovation of the systematic bird exhibit he was responsible for removal of the specimens from the cases and for cleaning and renovating the individual exhibits. He took part in the meetings of a committee on Arctic clothing, and on several occasions exhibited his colour transparencies of Arctic scenes for members of the government services.

J. Skillen and H. L. Shearman completed the preparation of most of the Oligocene mammals from Saskatchewan. Skillen began the preparation for the exhibition of an impressive skull of the dinosaur *Triceratops*. He also assisted in the rearrangement of the collection of fossil vertebrates. George Blanchard was responsible for the preparation of all of the skulls and bones of recent mammals, and made up some skins of birds and mammals for the study collection. S. W. Gorham joined the staff on January 14 and worked on zoological preparation.

Miss P. M. Hurlbert continued the compilation of ornithological literature in bibliographies and on distributional maps. She maintained the records of accessions and supervised the school loan collection.

Publications

Out-of-doors Museums. By Loris S. Russell, Bulletin of the Canadian Museums Association, vol. 5, No. 2, June, 1952.

Cretaceous Mammals of Alberta. By Loris S. Russell, National Museum of Canada, Annual Report for the Fiscal Year 1950-51. Bulletin 126, 1952.

Molluscan Fauna of the Kishenehn Formation, Southeastern British Columbia. By Loris S. Russell, National Museum of Canada, Annual Report for the Fiscal Year 1950-51, Bulletin 126, 1952.

Television and Museums—Second Report. By Loris S. Russell, Bulletin of the Canadian Museums Association, vol. 5, No. 4, 1952.

Birds of the Lesser Slave Lake – Peace River Areas, Alberta. By W. Earl Godfrey, National Museum of Canada, Annual Report for the Fiscal Year 1950-51, Bulletin 126, 1952.

Erroneous Records of Empidonax Wrightii in Manitoba and at Belvedere, Alberta. By W. Earl Godfrey, Canadian Field-Naturalist, vol. 66, No. 3, 1952.

Eleven reviews of literature. By W. Earl Godfrey, Canadian Field-Naturalist, vol. 66, 1952.

Nine reviews of literature. By W. Earl Godfrey, Bird-Banding, vol. 23, No. 4, and vol. 24, No. 1.

Hints on the Control of Small Mammal Pests in Eastern Canada. By Austin W. Cameron, National Museum of Canada Pamphlet, 1952.

Long-tailed Weasel near Quebec City. By Austin W. Cameron, Journal of Mammalogy, vol. 33, No. 2, 1952.

Notes on Mammals of Yukon. By Austin W. Cameron, National Museum of Canada, Annual Report for the Fiscal Year 1950-51, Bulletin 126, 1952.

Notes on a Small Collection of Mammals from Prince Edward Island. By Austin W. Cameron, National Museum of Canada, Annual Report for the Fiscal Year 1950-51, Bulletin 126, 1952.

The Mammals of Southeastern Quebec. By Austin W. Cameron, Annual Report of the Provancher Society of Natural History, 1950-51 (published 1952).

One review of literature. By Austin W. Cameron, Canadian Field-Naturalist, vol. 66, No. 3, 1952.

Zoological Investigations in the Maritime Provinces. By E. L. Bousfield, National Museum of Canada, Annual Report for the Fiscal Year 1950-51, Bulletin 126, 1952.

Notes on the Praying Mantis in Captivity. By E. L. Bousfield, Ottawa Field-Naturalists' Club News Letter, 15th February, 1953.

One review of literature. By E. L. Bousfield, Canadian Field-Naturalist, vol. 66, No. 5, 1952.

The Amphibians and Reptiles of Nova Scotia. By Sherman Bleakney, Canadian Field-Naturalist, vol. 66, No. 5, 1952.

Lectures

The Dentition of Rabbits and the Origin of the Lagomorpha. By Loris S. Russell, 32nd Annual Meeting of the American Society of Mammalogists, Charleston, S.C., April 15, 1952.

Palæontological Field Work in Flathead Valley, British Columbia. By Loris S. Russell, Society of Vertebrate Palæontology, Cambridge, Mass., November 15, 1952.

Museums and Schools. By Loris S. Russell, City View Home and School Association, January 6, 1952.

Horses, Horses, Horses. By Loris S. Russell, National Museum Children's Lecture Series, February 14, 1952.

Search for the Horse's Ancestors. By Loris S. Russell, Geology and Biology Clubs, Wayne University, Detroit, Mich., February 26, 1952.

Rise and Fall of the Dinosaurs. By Loris S. Russell, Cranbrook Institute of Science, Bloomfield Hills, Mich., February 27, 1952.

Our Winter Birds. By W. Earl Godfrey, National Museum Children's Lecture Series, November 8, 1952.

Bird Trails Across Canada. By W. Earl Godfrey, Province of Quebec Society for the Protection of Birds, Montreal, Que., December 15, 1952.

The Control of Small Mammal Pests. By Austin W. Cameron, 10th Annual Meeting of the Canadian Pest Control Operators' Association, Montreal, May 12, 1952.

Ecological Control of the Distribution of Barnacle Larvae in the Miramichi Estuary, New Brunswick. By E. L. Bousfield, American Society of Limnology and Oceanography, Ithaca, N.Y., September 10, 1952.

The Use of the Microscope in the Identification of Aquatic Micro-organisms. By E. L. Bousfield, Macoun Field Club, November 4, 1952.

The Various Types of Canadian Amphibians and Reptiles. By Sherman Bleakney, Macoun Field Club, December 6, 1952.

Learning to Appreciate our Universe. By Sherman Bleakney, Macoun Field Club, February 3, 1953.

A Summer in the High Arctic. By Stuart D. MacDonald, Bird Group of the Ottawa Field-Naturalists Club, January 8, 1953.

A Naturalist in the Arctic. By Stuart D. MacDonald, Ottawa Fish and Game Association, February 13, 1953.

Colour Glimpses of the High Arctic. By Stuart D. MacDonald, Colour Photographers Association of Canada, Inc., Ottawa Branch, March 2, 1953.

Adventures in the High Arctic. By Stuart D. MacDonald, National Museum Children's Lecture Series, March 21, 1953.

Accessions

Mammals

BY GIFT:

Bourguignon, A. E. Ottawa, Ont.: Richardson weasel.

Bryant, J. A., Department of Mines and Natural Resources, Game and Fisheries Branch, The Pas, Man.: 5 small mammals in formalin.

Cleghorn, J. D., Redpath Museum, McGill University, Montreal, Que.: 10 mammals from Eastern Townships, Quebec.

Dery, Dr. D. A., Quebec City, Que.: snowshoe hare.

Gorham, David, Brown's Flat, N. B.: short-tailed shrew.

Holland, G. P. Division of Entomology, Department of Agriculture, Ottawa, Ont.: 10 small mammals collected in Yukon by C. C. Loan.

Jones, Henry, Cloyne, Ont.: 3 skulls of snowshoe hare.

Pimlett, D. H., Cormack, Nfld.: 4 skulls and 3 skins of the black bear.

Superintendent, Rocky Mountain National Park, Banff, Alta.: 3 skulls of the black bear.

Taysom, A. R., Australian High Commissioners' Office, Ottawa, Ont.: mammal from Australia.

Waller, Samuel, The Pas, Man.: skull of bear.

MUSEUM EXPEDITION:

Cameron, A. W., and M. H. Ronalds, expedition to Anticosti Island, Gaspe Peninsula and Magdalen Islands: 68 mammals.

MacDonald, S. D., expedition to Prince Patrick Island, N.W.T.: 7 mammals.

Russell, L. S., and C. L. Thacker, expedition to Flathead Valley, B.C.: 21 mammals.

Birds

BY GIFT:

Andrew, E. H., Ottawa, Ont.: Brünnich murre.

Bartley, H., St. Eustache sur le Lac, Que,: great grey owl, great horned owl.

Bennett, Charles H., Ottawa, Ont.: bronzed grackle.

Bourguignon, A. E., Ottawa, Ont.: Brünnich murre, 7 redpolls.

Brown, H. M., Ottawa, Ont.: least flycatcher, ruby-throated hummingbird, robin.

Campbell, J. Mitchell, Ottawa, Ont.: Lincoln sparrow, northern water-thrush, red crossbill, brown thrasher from Lower Moisie River, Quebec.

Canadian Wildlife Service: whooping crane from Weyburn, Sask.; R. H. MacKay, Vancouver, B.C., 5 trumpeter swan skins, trumpeter swan skeleton; Leslie M. Tuck, St. John's, Nfld., brunnich murre, 3 Greenland wheatears, mallard duck, whitefronted goose (head and 2 wings); John S. Tener, 14 bird skins from Thelon River area, N.W.T.; T. S. Hennessy, chimney swift.

Cooch, Graham, Ottawa, Ont.: 61 salted bird skins and wing of snow goose from Southhampton Island, N.W.T.

Findlay, Douglas D., Carleton Place, Ont.: pigeon hawk.

Findlay, George E., Carleton Place, Ont.: wood duck, redpoll, evening grosbeak.

Gorham, David, Brown's Flat, N. B.: ruffed grouse, common redpoll, pine siskin.

Johnson, Claude E., Ottawa, Ont.: American golden-eye.

Jones, Henry H., Cloyne, Ont.: least flycatcher, red-eyed vireo.

Laroche, Jangi, Hull, Que., barred owl.

Mills, Eric, Ottawa, Ont.: parula warbler.

Ommaney, G. G., Hudson Heights, Que.: 13 bird skins.

Reynolds, Keith, London, Ont.: eider duck.

Royal Canadian Mounted Police, Constable C. K. Sargent: yellow-billed loon from Spence Bay, Boothia Peninsula, N.W.T.

Stirrett, Dr. George M., and Constable Paul W. Holmes, Kingston, Ont.: 14 bird skins from James Bay and Kingston, Ont.

Strong, B. I. M., Superintendent, Prince Albert National Park, Sask.: great horned owl.

Taysom, A. R., Australian High Commissioner's Office, Ottawa, Ont.: 15 mounted birds from Australia.

Waller, Samuel, The Pas, Man.: 2 sets of bird's eggs.

Wilson, J. A., Ottawa, Ont.: mummified falcon from Egypt.

Wolf, G. E., Foremost, Alta.: pintail.

MUSEUM EXPEDITION:

Godfrey, W. E., and J. A. Crosby, expedition to Prince Edward Island: 264 bird skins.

MacDonald, S. D., expedition to Prince Patrick Island, N.W.T.: 43 bird skins.

Russell, L. S., and C. L. Thacker, expedition to Flathead Valley, B.C.: 54 bird skins

BY MEMBERS OF STAFF:

Crosby, J. A., Ottawa, Ont.: yellow-shafted flicker.

Godfrey, W. E., Ottawa, Ont.: white-breasted nuthatch, broad-winged hawk.

Reptiles, Amphibians, and Fish

BY GIFT:

Alexander, Flt. Lt. S. W., Ottawa, Ont.: Texas horned lizard from Florida.

Anderson, Mrs. M., Cornwall, Ont.: red-bellied snake.

Bardach, J. E., Iowa State Teachers College, Cedar Falls, Iowa: one lot of fish from the Thelon Game Sanctuary, N.W.T.

Baltzer, Joe, Wolfville, N.S.: 2 ring-necked snakes.

Campbell, J. Mitchell, Ottawa, Ont.: 4 garter snakes from Sept Iles, Quebec.

Carter, Nick, Aylmer, Que.: Jefferson's salamander.

Cuerrier, J. P., Ottawa, Ont.: mud puppy from Muskrat Lake, Ont.

Dominion Parasite Laboratory, Belleville, Ont.: 2 lots of fish from Hastings County, Ont.

Fisher, Dean, St. Andrews, N.B.: spotted newt.

Fontaine, Arthur, Montreal, Que.: 20 salamanders.

Huntsman, Dr. A. G., Toronto, Ont.: 36 lots of fish from Miramichi Estuary, N.B.

Krivda, W., Ottawa, Ont.: 21 wood frogs, 3 lots of fish from The Pas, Man.

Osborn, Dale J., Boston, Mass.: 19 toads with eggs and tadpoles, and 3 wood frogs with eggs and tadpoles from Menikeh Lake, Labrador.

Schad, G. A., Institute of Parasitology, Ste-Anne de Bellevue, Que.: 32 snakes of five species.

Scott, W. B., Royal Ontario Museum of Zoology and Palæontology, Toronto, Ont.: approximately 300 fish of 14 species from the Algoma District, Ont.

Watts, Ann, Halifax, N. S.: 2 ring-necked snakes.

MUSEUM EXPEDITION:

Godfrey, W. E., and J. A. Crosby, expedition to Prince Edward Island: garter snake, 2 toads, and a wood frog.

MacDonald, S. D., expedition to Prince Patrick Island, N.W.T.: approximately 90 fish.

Russell, L. S., and C. L. Thacker, expedition to Flathead Valley, B.C.: 2 northwestern toads and a red-sided garter snake.

BY MEMBERS OF STAFF:

Bleakney, Sherman, Ottawa, Ont.: 691 amphibians and reptiles and approximately 200 fish from Eastern Canada.

Cameron, A. W., Ottawa, Ont.: painted turtle from Georgian Bay, Ont.

Invertebrates

By Gift:

Bardach, J. E., Iowa State Teachers College, Cedar Falls, Iowa: 35 lots of freshwater planktonic and bottom invertebrates from Thelon Game Sanctuary, N.W.T.

Canadian Wildlife Service, V. E. Solman: 42 lots of freshwater plankton from lakes of Alberta, Saskatchewan, Ontario, and Nova Scotia.

Dominion Parasite Laboratory, Belleville, Ont.: 5 lots of freshwater snails, 2 lots freshwater crustaceans, 1 lot annelids from Chatterton, Hastings County, Ont.

Fisheries Research Board of Canada, Dr. A. G. Huntsman, Toronto, Ont.: (1) 517 lots marine planktonic invertebrates and 89 lots mostly bottom marine invertebrates from Miramichi Estuary, N.B.; (2) 29 lots crustaceans from eastern Canada; (3) 28 lots mostly bottom marine invertebrates from Eastern Canada.

Hocking, Dr. B., University of Alberta, Edmonton, Alta.: 3 lots of coelenterates, collected by E. F. Pope from Churchill, Man.

Holland, G. P., Division of Entomology, Department of Agriculture, Ottawa, Ont.: 10 lots of miscellaneous invertebrates collected by W. Krivda from The Pas, Man.

Palmen, Dr. Ernst, Zoological Institute, Helsinki, Finland: 54 lots crustaceans, 4 lots diplopods from Newfoundland.

Troelsen, J. C., Department of Mines and Technical Surveys, Ottawa, Ont.: 15 fossil marine molluscs from Star Island, Eureka Sound, N.W.T.

By Exchange:

Eyerdam, Walter J., Seattle, Washington: 14 lots of *Thais* spp. (67 specimens) for 17 lots of *Thais lapillus* (90 specimens).

Museum Expedition:

Godfrey, W. E. and J. A. Crosby, expedition to Prince Edward Island: 5 lots molluscs.

MacDonald, S. D., expedition to Prince Patrick Island, N.W.T.: 58 lots invertebrates (mostly marine), 1 lot crustaceans, 1 vial parasitic marine copepods.

Russell, L. S., and C. L. Thacker, expedition to Flathead Valley, B.C.: 1 lot land snails (Oreohelix)

Fossil Vertebrates

By Gift:

Cochrane, Robert, Grande Prairie, Alta.: fossil horse bones from Smoky River Valley, Alta.

By Exchange:

Royal Ontario Museum of Zoology and Palæontology, Toronto, Ont.: complete lower jaw of "giant pig" *(Archaeotherium coarctatum)* from Oligocene of Saskatchewan, for a skull and lower jaw of fossil horse *(Merychippus)* from Miocene of Nebraska.

Museum Expedition:

Russell, L. S., expedition to Flathead Valley, B.C.: fossil mammals from the Kishenehn formation (Upper Eocene).

Lindblad, G. E., expedition to Cypress Hills, Sask.: fossil mammals from the Cypress Hills formation (Lower Oligocene).

Miscellaneous

By Gift:

Provincial Museum, Regina, Sask., F. G. Bard, Director, motion picture film in colour showing fossil collecting in the Cypress Hills, Sask.

NATIONAL HERBARIUM

Field Work

I. Mackenzie Lamb left for the field on June 9, 1952, and worked in Cape Breton, N.S., until September 4. He made collections of cryptogams for the National Herbarium and field studies and photographs in natural habitats of lichens. The total number of collections made was 431, with sufficient material to make up about 1,200 duplicate specimens for distribution in exchange to other institutions and individuals.

W. K. W. Baldwin, assisted by A. J. Breitung, from June 10 to September 17, made a botanical survey of the clay belt region of northern Ontario and Quebec. The collections of vascular plants totalled 2,332 numbers, representing approximately 750 species and major varieties. Of most numbers ample duplicates were secured for the purpose of exchanges. Numerous ecological notes and photographs of plant habitats were obtained.

Office Work

A. E. Porsild, Chief Botanist, completed the first draft of a 139-page manuscript on the flora of the Western Arctic Archipelago and made considerable progress with a paper on the flora of the Mackenzie Basin. He also commenced work on a conventional manual of the flora of the Canadian Arctic Archipelago which, besides line drawings and distribution maps, will contain keys and descriptions of all species known from that area. He also wrote a paper on *Edible Plants of the Arctic* for ARCTIC, and another entitled *Land Use in the Arctic* for the Canadian Geographic Journal. He also translated from the original Swedish a paper entitled *The Boreal Limits of Conifers*, by I. Hustich. He also checked and revised proofs of various papers and reviewed manuscripts submitted for publication in ARCTIC.

Mr. Porsild attended meetings of the Board of Governors and of the Executive of the Arctic Institute of North America in Montreal, New York, and Ottawa, besides meetings of the Advisory Board on Wildlife Protection, the annual Provincial-Federal Wildlife Conference, and of the Interdepartmental Council on Eskimo Affairs. From June 19 to July 5 he visited the Gray Herbarium of Harvard University for the purpose of checking distribution and taxonomy of certain Arctic plants, and on January 8 and 9, preceding a meeting in New York of the Arctic Institute, he carried out library research in the Herbarium of New York, Botanical Garden of New York. From September 7 to 10 he attended the annual meeting of the American Institute of Biological Sciences held at Cornell University, Ithaca, N.Y., and in conjunction with this, took part in a meeting of Herbarium Curators. During the year he spent much time collating information assembled over the past 25 years on the distribution of 2,000 Arctic and boreal plants. This information was transferred from preliminary maps to a more permanent set of base maps. He determined 893 plant specimens submitted for report by various government departments, by Canadian or foreign universities and botanical institutions, or received as gifts or by exchanges; checked 5,583 specimens prior to mounting and inserting into the Herbarium, and spent two weeks making up eight duplicate sets for distribution to other herbaria of his collections from the Mackenzie District, 1927 to 1928, 1932 to 1935, and in 1947, and from Hudson and James Bay, 1929 to 1930.

H. J. Scoggan spent considerable time checking the determinations of the more critical plants collected by him during four field seasons in Manitoba, and made much progress on flora of the Lake Agassiz Basin and adjacent regions of Manitoba. He prepared six articles on Canadian wildlife, entered the ranges of Manitoba plants on the set of plant distribution maps compiled by Mr. Porsild, studied and revised 532 specimens of critical Manitoba specimens loaned by other institutions, named 222 plants from Manitoba and 335 from other parts of Canada, which had been submitted during the year for determination, and checked the determination, as needed, of 664 plants prior to mounting. Further progress was made in the arrangement and classification of the Lawson Herbarium, of which the contents of 20 cartons was checked and sorted prior to mounting and inserting into the National Herbarium. From October 1 to 20, 1952, he visited the Gray Herbarium of Harvard University for the purpose of checking critical specimens in his collection of Manitoba plants.

I. Mackenzie Lamb determined the greater part of his lichen collection of 1952 from Cape Breton, N.S., and at the same time revised the lichen material collected there by John Macoun in 1898, determined part of his own collections from the Rocky Mountains made in 1951, and named various collections of lichens submitted for determination by various government departments and by other botanical institutions. He prepared a classification system for the rearrangement of the National Museum's Moss Herbarium, and continued, largely outside office hours, with the preparation of a report on the lichen flora of Argentine Patagonia, based mainly on his own collections made there in 1950. He assembled materials for a paper on *Primitive Fruticulose Catillariales*, now in preparation, and started to elaborate it for publication. He completed a manuscript entitled *New, Rare, and Interesting Lichens from the Southern Hemisphere II* for publication in LILLOA.

W. K. W. Baldwin wrote a report on his botanical investigations in northwestern Manitoba in 1951, checked and revised proofs of two papers on the flora of James Bay and Foxe Basin, which were published in the Annual Report of the National Museum, 1951–52, and wrote a short note on Fort Temiscamingue for the National Parks and Historic Sites Division, besides miscellaneous book reviews on conservation and gardening. During April and May he made routine insertions in the Herbarium, and during the rest of the year prepared plant materials to be sent on loan to other botanical institutions. During the winter, good progress was made with the determination of plants resulting from his field work in northern Ontario and Quebec.

Besides routine maintenance of the herbarium, which includes mounting and filing of botanical specimens and reprints, and indexing and cataloguing of botanical information and data, several thousands of herbarium mounts were repaired or remounted; new and permanent genus separators were prepared and inserted, and the specimens in the Canadian and European collections rearranged as needed, following the installation of ten new herbarium cases. One hundred and seventeen type specimens were collated and indexed, thereby bringing the number of indexed types in the Herbarium to 1,469.

One hundred and seventy-two visitors from Canada and abroad visited the National Herbarium of Canada to study specimens in the collection or to consult members of the staff on technical matters.

Accessions, Loans, and Exchanges

During the year 5,122 herbarium specimens were received by exchange, 1,514 by donation, and approximately 11,833 resulted from field work or were obtained in exchange for determinations by members of the National Museum staff. A total of 5,411 specimens were sent on loan to other botanical institutions, and 933 were borrowed from them. Duplicate specimens resulting from the field work of the Herbarium staff totalling 8,368 were distributed to Canadian and foreign herbaria in continuation of exchanges. A total of 5,583 specimens of vascular plants were mounted and inserted in the herbarium, bringing the total number of mounted vascular plants in the National Collection to 220,965. When the reorganization of the collections of mosses, lichens, and algae in the cryptogamic herbarium has been completed, the total number of plants in the National Herbarium will be very considerably increased.

The National Museum gratefully acknowledges the donations of the following specimens and collections:

Department of Agriculture, Granada, B.W.I.: 7 cryptograms from British West Indies.
Charles Bostock, Ottawa: 53 lichens from the Yukon.
Mrs. Jack Bollerud, Ottawa: vascular plant from Quebec.
A. J. Breitung, Ottawa: 51 vascular plants from Manitoba, Saskatchewan, and Ontario.
A. Budd, Swift Current: 5 vascular plants from Saskatchewan.
F. N. Cowell, Timmins, Ont.: vascular plant from Ontario.
Herbert Groh, Ottawa: vascular plant from Ontario.
W. W. Heywood, Ottawa: 19 vascular plants from Isachsen Island.
Walter Krivda, The Pas, Man.: 26 vascular plants from Manitoba.
Fr. E. Lepage, Rimouski: 80 vascular plants from W. James Bay watershed.
Hoyes Lloyd, Ottawa: 8 vascular plants from Florida, Louisiana, and Ontario.
S. D. MacDonald, Ottawa: 158 plants from Prince Patrick Island.
T. H. Manning, Ottawa: 120 vascular plants from Banks Island.
J. R. Mackay, Geographical Branch, Ottawa: 36 vascular plants from Cornwallis Island.
E. H. McEwen, Aklavik: 10 vascular plants from Northwest Territories.
J. A. Munro, Okanagan Landing, B.C.: 2 vascular plants from British Columbia.
M. P. Porsild, Copenhagen: 3 vascular plants from Greenland.
Mrs. L. S. Russell, Ottawa: 500 vascular plants from British Columbia.
E. A. Schelpe, Punjab, India: 2 lichens from Punjab.
H. J. Scoggan, Ottawa: 59 vascular plants from Quebec.
F. A. Sowter, Leicester, England: 1 lichen.
V. C. Wynne-Edwards, Aberdeen, Scotland: 114 mosses from Baffin Island.
J.S. Tener, Wildlife Service, Ottawa: 164 vascular plants from Thelon Game Sanctuary.
Johannes C. Troelsen, Copenhagen: 55 vascular plants from Ellesmere Island.
Geo. H. Turner, Ft. Saskatchewan: 35 vascular plants from Saskatchewan.

Publications

The following articles, reviews, and papers were published during the year by members of the staff of the National Herbarium:

Edible Plants of the Arctic, by A. E. Porsild, Arctic 6: 15-35 (1953).
Review of "People of the Deer", by A. E. Porsild, Beaver, 1952, pp. 47-49.
Botanical Investigations in Manitoba in 1950, by H. J. Scoggan. National Museum of Canada. Bull. 126: 208-227 (1952).

Lectures

Canada's Reindeer, by A. E. Porsild, Ottawa Y.M.C.A., Ottawa, February 27, 1953.
"Lichens", by I. Mackenzie Lamb, Macoun Field Club, March 10, 1953.

THE STOTT MOUND AND VILLAGE, NEAR BRANDON, MANITOBA

By Richard S. MacNeish

INTRODUCTION

When were the mounds of Manitoba built? Why were they built? Who were the mound builders? What was their culture? What happened to them? The solution of these historical problems was the goal of the archæological investigation of the National Museum in Manitoba in October of 1952.

Manitoba's Indian mounds have piqued the curiosity of local inhabitants and visitors for a considerable length of time. Hind, in 1858, was sufficiently intrigued to investigate one,[1] and many others have been dug into since that date. With the exception of the field parties under the direction of Nickerson, Rand, and Vickers, most of the digging of the mounds comes under the heading of looting. The artifacts, skeletal material, and other information from the promiscuous digging has, for the most part, disappeared, and thus segments of Canada's prehistory has been irrevocably lost. Nickerson, in 1913 and 1914, carefully excavated a number of Manitoba mounds, and the material uncovered has been preserved in the National Museum of Canada,[2] but the materials have never been analysed nor the results published. Materials from the various mounds that Rand's parties excavated are still in existence, but no extensive reports on them have ever been published.[3] In spite of these previous investigations, only Christopher Vickers' analysis of Manitoba mounds has brought definite evidence to bear upon the problems concerning Manitoba's prehistoric tumuli, and he has published a number of articles upon the subject.[4] Since Vickers had never dug an untouched mound or an associated village site of the builders of the mounds, he suggested that he and the writer excavate the Stott Mound and Village Site (on which Dr. Bird had already dug with a good deal of success)[5] to get the final evidence for the solution of the problems of the mounds. Unfortunately, just as digging was about to begin, Vickers was not available because of business reasons, and (with his permission and insistence) the task of excavating the mound was left to the author.

The Stott Site (called M49 in the archæological survey report of Manitoba undertaken by the National Museum of Canada) is located in the southwest quarter of Section 35, Range 20, Township 10, west of the First Meridian, about eight miles west of Brandon. The site is situated on the north side of the Assiniboine Valley between one-half and three-quarters of a mile from the Assiniboine River, about a mile below its junction with the Minnedosa River.

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[1] H. Y. Hind, 1859.

[2] W. B. Nickerson, 1914.

[3] Rand, 1941 and 1945.

[4] C. Vickers, 1947.

[5] Dr. R. D. Bird. *The Stott Site,* unpublished manuscript, a copy of which is in the files of The National Museum of Canada.

The Stott Mound is located at the edge of a flat plain, a few yards north of the steep sides of the Assiniboine Valley. From the mound, there is a rather impressive view of the valley as well as of the Brandon Hills to the south. Below the mound, on the top two or three terraces or alluvial benches which extend east along the north flank of the valley for one-quarter of a mile from a point just down the bank from it, there is village refuse. The two lower terraces along the north flank of the Assiniboine River are relatively sterile of human remains, and thus the flat valley in front of the site seems to have been unoccupied. The greater part of the site is now covered by small oaks and is relatively protected from the cold winds that sweep the valley and the plains above the valley. Mr. Frank Stott has erected a house and other buildings. He has also cleared, for cultivation, a small part of the southern edge of the site, which once was entirely hidden by trees.

Although from boyhood Mr. Stott had recognized that the small bump at the top of the valley was an Indian mound and had taken care not to cultivate on it or allow it to be molested, it was not until 1945, when excavating for the cellar of his house, that he located the village site. At that time he had the presence of mind to inform Dr. Ralph Bird of the Dominion Entomological Laboratory in Brandon. This was a happy choice, as Dr. Bird was sincerely interested in archæology and had a scientific background that made him proceed with caution. Dr. Bird, after a brief survey of the site in 1946, informed L. T. S. Norris-Elye of the Manitoba Museum, and C. Vickers of Baldur, Manitoba. Vickers and Bird visited the site in the summer of 1946, and plans were made for excavation in 1947. Vickers, Charlie Bird, and Dr. Ralph Bird began digging in 1947. Later, Ralph Bird, assisted by Mrs. Bird, his son Charlie Bird, Frank Stott, Stuart Criddle, and Mr. Richardson, continued the excavation during the next three summers. All the excavations were carried on most carefully, and the data were meticulously recorded. In 1950, the writer was informed of the site and in 1951 was invited by Messrs. Bird and Vickers to excavate the mound during the field season of 1952.[1]

THE EXCAVATION OF THE MOUND

On September 28, 1952, an area 35 feet (east-west) by 45 feet (north-south), encompassing all of the mound, was staked out into fifty-six 5-foot squares oriented along the cardinal axis by use of a plane table and alidade and two 50-foot steel tapes. One stake in the centre of the area was number 0–0, while a stake 5 feet east was called E 5, and another 5 feet west and 10 feet south was called S 10 W 5. In such a manner all stakes had a number, and every part of the mound could be recorded in terms of the distance north, south, east, and west of the 0–0 stake. The 5-foot squares set up were named after the designation of the stake in their southeast corner.

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[1] I should like to express my gratitude to Frank Stott, not only for his hospitality and assistance during the excavation but also for his foresight in saving the mound for scientific excavations. Also I should like to thank his wife for her hospitality, and his son for his assistance and interest. I also appreciate Dr. Ralph Bird's invitation to dig on the site, his co-operation and physical help during the excavation, and the privilege of studying the material which he so carefully excavated. Dr. Bird and his family also made my stay in Brandon exceedingly pleasant. Mr. Vickers is to be thanked for his survey effort at the site and for urging me to dig on the site. Gordon Hoover of Melita, Manitoba, was my constant companion and co-excavator during the whole project. Mr. and Mrs. Fred Thompson of Portage du Prairie, J. Elson of Ottawa, Stuart and Harvey Criddle of Treesbank, Mr. and Mrs. W. Richardson, R. Hannah, W. B. Keller, M. Stevens, Dr. J. Elliott, W. Wilson, G. Kinnear, W. Curtis, and D. Arnust of Brandon, also helped during the excavations.

Datum depths were also taken on each stake, and a 6-inch contour map was prepared from these data (Figure 1). The contour map revealed that the mound was roughly oval in outline, about 60 feet long east and west, and 50 feet wide north and south. The mound was about two and one-half feet high with a flattish top, and its southern slope gradually blended into the sloping bank of the valley. Also, from the datum depth, it was possible to draw the vertical outlines of the mound along each 5-foot grid line, both north-south and east-west on graph paper with one-quarter inch equal to one foot. Several photographs were taken of the mound before excavation.

In order to determine the outside limits of the mound as well as the stratigraphy outside of the mound, the first four excavations were made in four 5-foot squares just outside the main staked areas along the middle of each side. These squares were dug by shovel and screen in arbitrary 6-inch levels, and the profiles of their walls were drawn on the vertical outlines of the mound prepared on the graph paper.

Work was then begun in the staked areas along the north and south edges. In the northern position two alternate squares N 1 SW 5 and N 1 SE 5 were excavated first in arbitrary 6-inch levels by horizontal slicing with shovels down to yellow clay. When these squares were completed, the profiles of their vertical walls were revealed. Then the squares between (N 15 and N 15 E 10) were removed down to the basic sub-soil by the same method. This excavation supplied a 20-foot trench, 5 feet wide, extending down to the basic clays. Wall profiles were again cleaned and drawn, and the two longer walls were photographed. In the next set of squares farther south a trench 5 feet by 30 feet was then removed in the same manner. In the meantime, three trenches were removed by the same method from the south section of the staked area, one from the east part and one from the west part. By this time, the edges of the artificially constructed mound had been exposed, and the old humus below the mound was apparent (Plate I, 1). During this process a slight change in technique was made necessary by the uncovering of a firepit. This feature was uncovered by trowel, sketched on graph paper, and photographed before, during, and after excavation. Also, the squares were now dug not in arbitrary levels, but in terms of the five soil zones: modern humus, mound fill, top of the old humus, old humus, and the basic clays (Plate I, 2). The system of digging by alternate squares was continued, and records were kept of the profiles by sketches and photographs. This technique continued until the north and south trenches were connected down to the clays around the centre and down to the top of the humus in the centre of the mound. The final stage of the excavation was the removal of the old humus at the centre of the mound and various features below it. At this time all digging was done by trowel, and as each part of the various features were uncovered and cleaned off, they were sketched and photographed from a tower above the 0–0 stake. Also, cross-sections were still drawn, and the various strata or features were sketched on the cross-section drawings as they were uncovered. After the excavation was completed and material uncovered and recorded as to its original location, the soil was replaced by a bull-dozer.

On the basis of the material, strata, and features uncovered, it is now possible to make a fairly complete reconstruction of the sequence of events that occurred at the Stott Mound (Figure 2). Zone H, representing sand that was blown into this area during the Pleistocene, is the earliest event of which there is record in the excavation.[1] Zone G, a one- to two-foot layer of clay, overlaid the sand and seems to have been the result of colluvium deposited during the last of the Pleistocene or in the early Recent period.[2] Somewhat after that period a humus (Zone F) formed on the clay, from the rotting of vegetation. All three of these strata and events occurred before the advent of man into this area of excavation. At this time the area of excavation was a relatively flat plain which sloped off abruptly to form a steep bank. On top of the humus, near the centre of the area of excavation, was a deposit of charcoal; whereas to the east there was a thin layer of ash covering the humus. In this strata, Zone E, above the old humus, were a few flint chips, a blade fragment, part of a small triangular end-scraper, and a few pieces of cracked buffalo bone. This zone evidently represents a layer that was very briefly occupied by the builders of the mound (Figure 3). Dug down from this Zone E at N 11·5 W 12·1 was a small conical fire-pit (Pit I), one and one-half feet in diameter and about seven inches deep, which was filled with charcoal and ash; whereas at N 4·3 W 13·4 there was vertical-sided flat-bottomed Pit II, about two feet in diameter and eight inches deep, filled with four large fire-cracked rocks and charcoal.

Beside the fire-pits, three large pits for burials had been dug down from Zone E. Whether the fire-pits were used in conjunction with the burial ceremonies, or whether the fire-pits represent a short occupation unconnected with the burials, is not indicated by definite evidence. However, the lack of very much refuse around the fire-pits, the nearness of the fire-pits to the burial pits, and the fact that fire-pits often occur in burial mounds in Manitoba, led to the inference that the fire-pits were probably connected with the burial rites.

The smallest of the burial pits (Pit III) was oval in outline and was 2½ feet long (east-west) and 22 inches wide (Plate I,3). It was roughly subconoidal, being about fourteen inches deep. Pit III contained a curled-up, immature dog skeleton (XV-A-103) with its nose pointing eastward and its back to the north (Figure 4). The pit was filled with loose, fine dirt and covered over with a single wide log of oak and fine flecks of wood, a state suggesting that the burial pit was once totally covered with logs (Figure 5). Furthermore, the texture and lack of bedding of the dirt in the pit makes one suspect that this burial pit was roofed over and not originally filled, and that, when the logs rotted away, dirt from the mound above filtered into it.

Jus[illegible] east of the dog burial was Pit IV which, in its upper part, connected with Pit V to its southeast (Figure 4 and Plate II, 1, 2). Pit IV was roughly oval in shape and 7½ feet long (northeast-southwest), 4½ feet wide, and was about 3 feet deep. It was in Square 0–0 and the west part of E 5. The sides sloped gradually inward and the bottom was flat, being only 4 feet long and 1½ feet wide. In the bottom of this pit was placed a loosely flexed burial of an adolescent (male?) (XV-A-101). It was lying on its right side, facing north, and with its head pointing east. The burial had been sprinkled with red ochre, and a clam shell, a short tubular columnella bead, and a bird-bone flute or whistle were placed near its head. Over this burial had been placed a large piece of elm bark about four feet long and two feet wide (Plate III, 2). On top of the elm bark was a bundle burial of another adolescent (XV-A-102). On top of both burials in the east part of the pit had been placed three buffalo skulls, ventral sides up, and four boulders. Over these were two layers of oak poles (Figure 5).

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[1] J. A. Elson, Geological Survey of Canada, personnel communication.

[2] Ibid.

Pit V was located in the northern three-quarters of Square S 5 E 5 (Figure 4). It was roughly four feet in diameter with almost vertical walls four feet deep and had a flat bottom about three to three and one-half feet in diameter. Into this pit had been first placed an infant bundle burial (XV-A-98) in the southeastern part, and an adolescent flexed burial (XV-A-99) in the north part. The child burial was on its left side with the head pointing southeast and evidently originally had been in a sitting position. Both had been sprinkled with red ochre. Above the bundled baby burial and slightly east of it was a tightly-flexed adult (approximately 40 years old) male (SV-A-97), lying on his left side with head to the southeast. This was also originally in a sitting position. To the west of the adult male, partly over the child burial, were the bones of an old (over 60 years) woman (Plate III, 1). At first glance it seemed to be a tightly-flexed burial on its left side with its head pointing southeast (XV-A-96). However, on further excavation it became apparent that both arms were on the left side, and while the left leg was articulated on the left side, the right leg was doubled up so that part of the lower leg was behind the vertebræ and the knee was next to the scapula. Because of these incorrect positions of the bones, it is thought that this individual was either only partly articulated at the time of burial or was totally disarticulated, and that some ancient anatomist attempted to arrange the bones so that the burial looked like a flexed burial. Because of that correct alinement of ribs and fingers, the former is the correct hypothesis. Both these adult burials had been sprinkled with red ochre, and the adult male burial bore remnants of either a green powder or copper stain in its stomach region. The final human remains in the pit were two articulated arms minus the hands that lay vertically against the south wall of the pit. They also were sprinkled with red paint.

The whole of Pit V had been covered over by two layers of well-preserved oak and cedar poles that, in the main, ran from southeast to northwest (Figure 5).

Over part of the burial pits, on top of some of the logs of the pits and over Zone E surrounding the pits, was a 2-inch thick layer of hard-packed puddled clay, called Zone D (Figure 2). This appears to be a purposive clay covering of the burial pits and is definitely not part of the loading.

Over Zones D and E were loadings of dirt that the ancient people had brought to build the mound, Zone C (Figure 2). Whether these were basket-loads or sacks of dirt we do not know, but it is probable that they were basket-loads of dirt since parts of actual baskets have been found with loads in Mississippi mounds to the south[1] and since Nickerson mentions the imprint of a basket in the loading of a mound near Sourisford.[2] Excavation revealed that the original mound built was only about thirty-five feet in diameter, while cross-sections show that the slope of the original mound was much steeper than that of the present mound and that the original mound may have been over four feet in height (Figure 6).

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[1] Cole, 1952, p. 21.

[2] Nickerson, 1914.

One intrusive oval pit (VI) (Figure 6 and Plate III, 3) had been dug into the mound at N 5 E 3·5. This pit was 3 feet long from east to west and about 1½ feet wide. Pit VI contained a loosely-flexed adolescent burial (XV-A-104) lying on its left side with its head to the west. A single columella bead and six oliva beads occurred in the region of the neck. Pit VI seems to be the last work of man at the Stott Mound.

Following the building of the mound, erosion took place and an alluvial fan was formed around the mound. The fan is called Zone B. The last event in the mound's history was the building of the present humus (Zone A) over the mound and the alluvial fan.

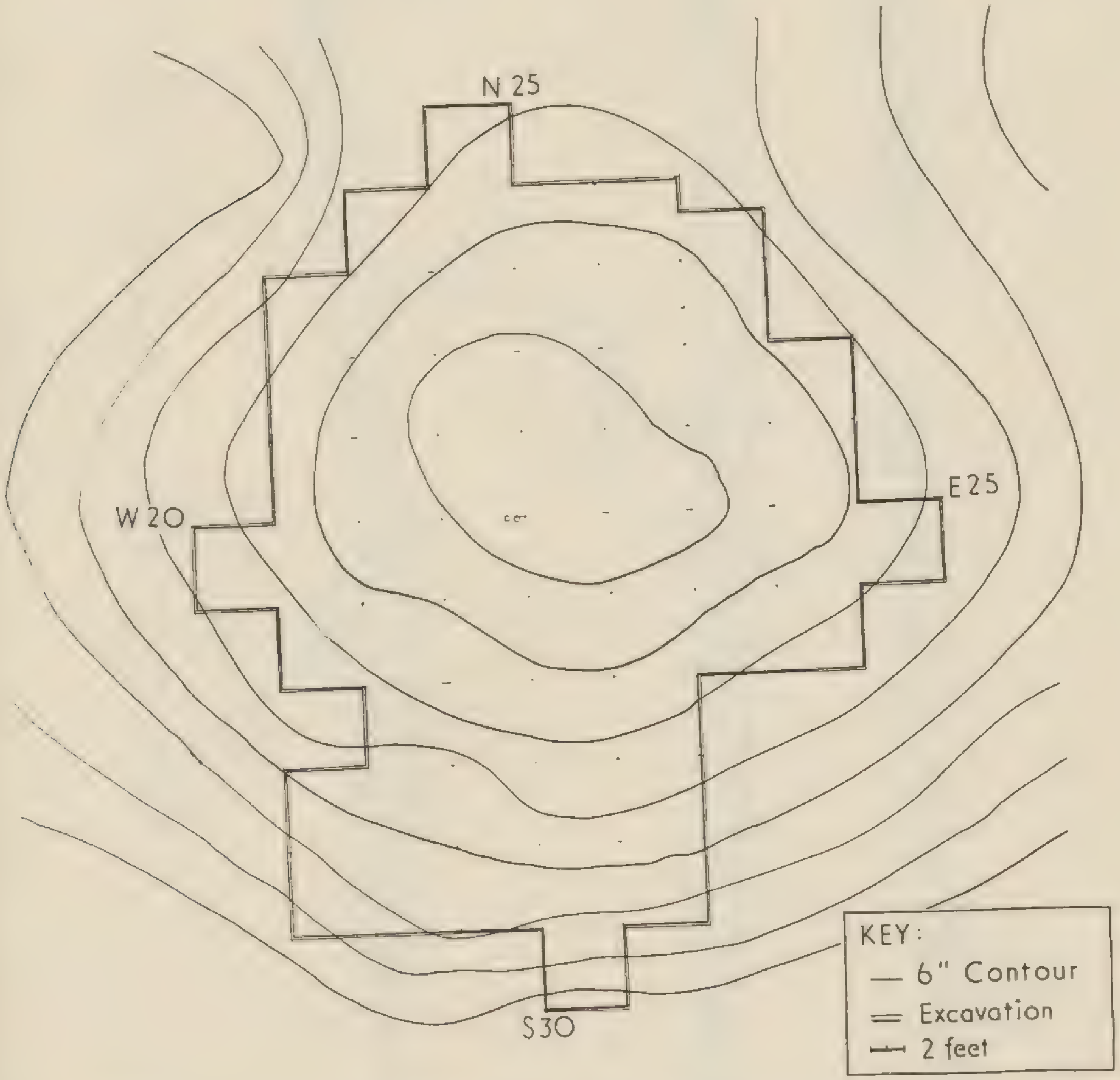

Figure 1. Six-inch contour map of Stott mound showing area at excavation.

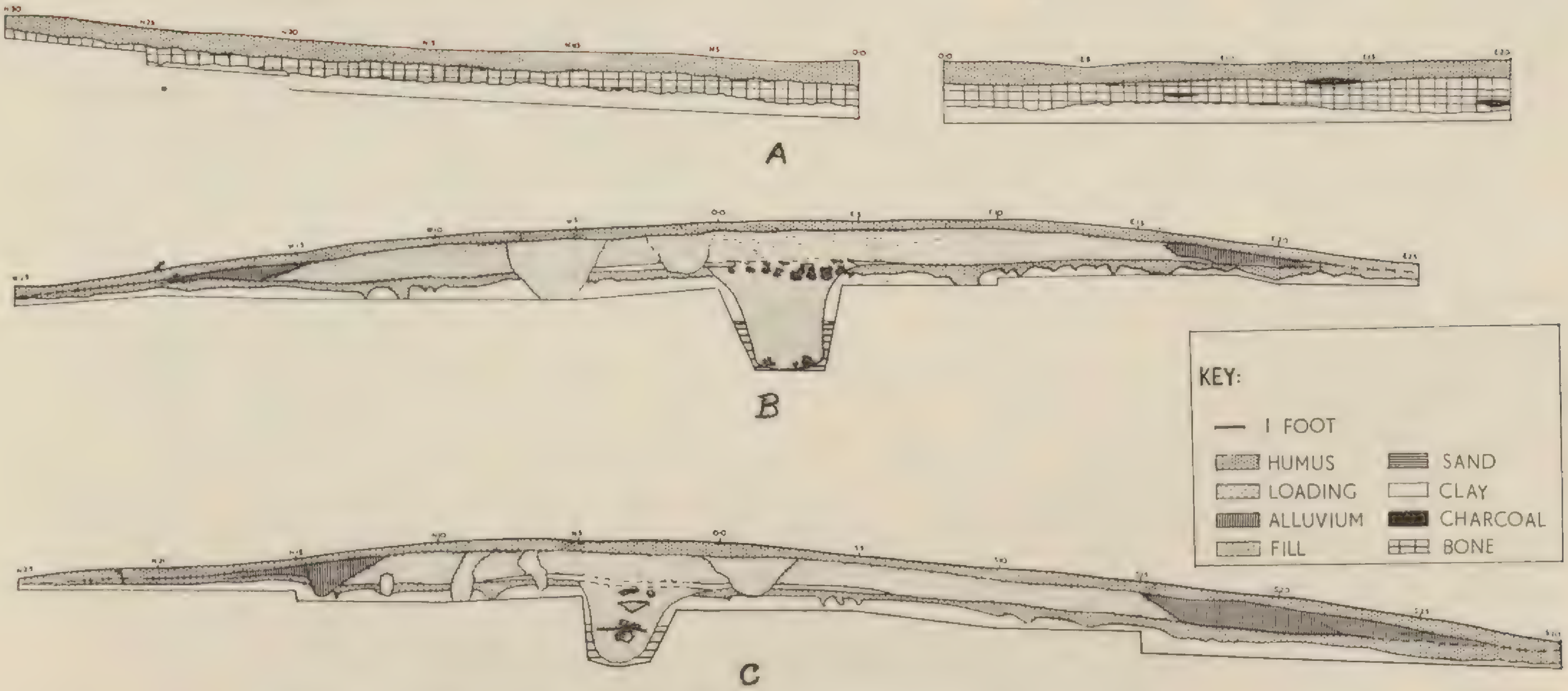

Figure 2. Cross-sections of excavations.
A. Cross-sections in the village site.
B. West-east cross-section through the centre of the Stott mound.
C. North-south cross-section through the centre of the Stott mound.

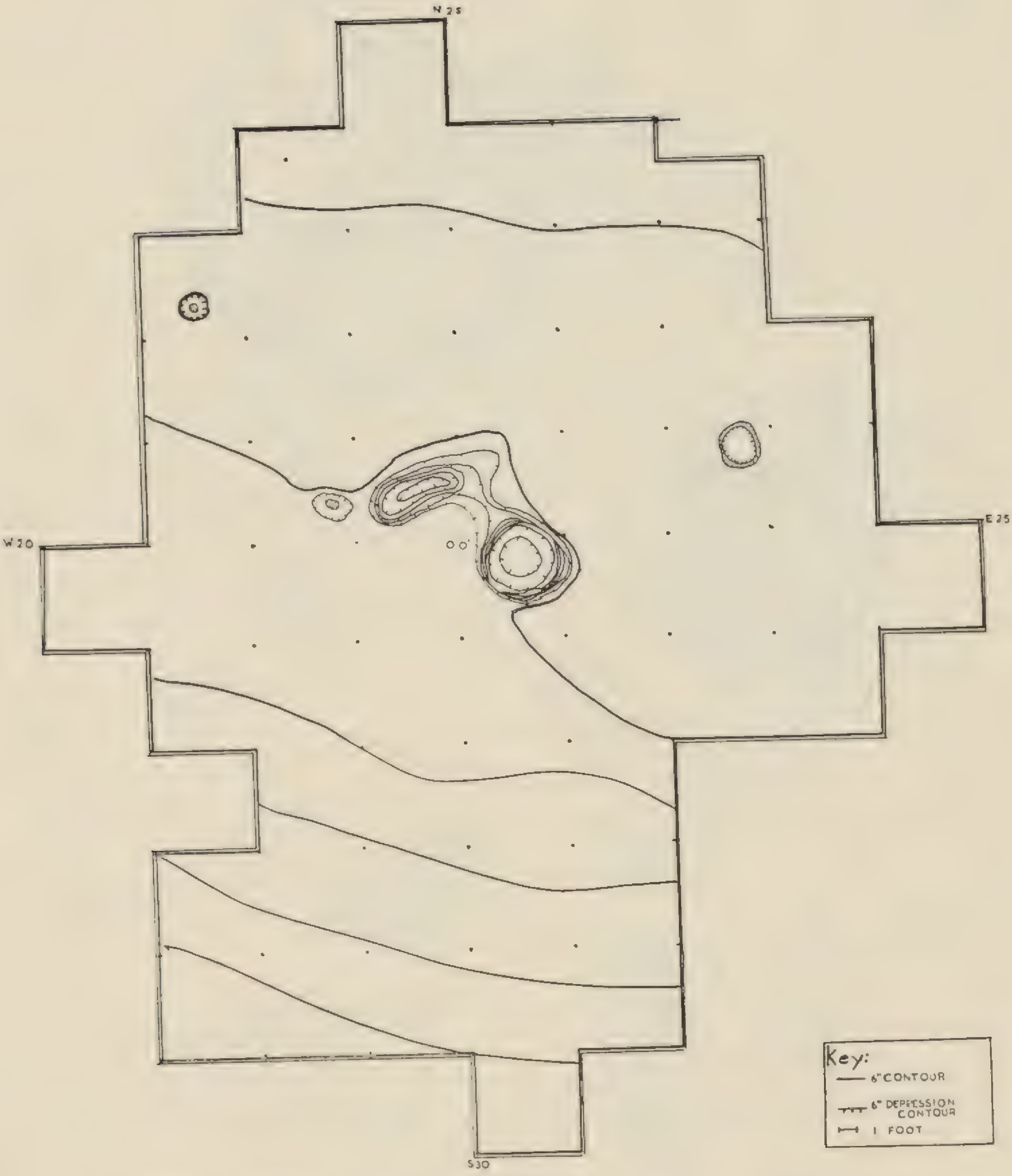

Figure 3. Six-inch contours of old humus with its associated features.

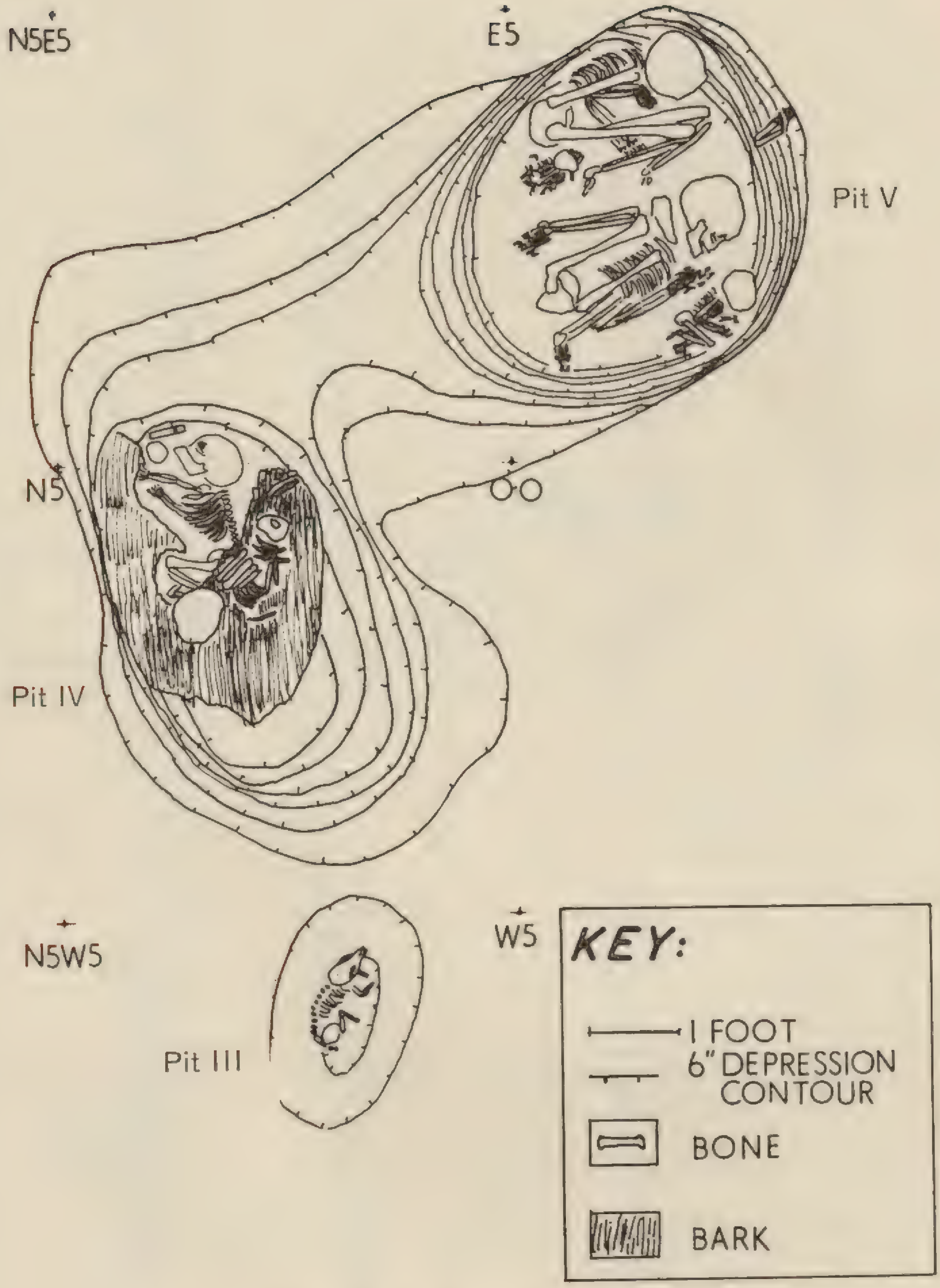

Figure 4. The burial pits in the centre of the Stott mound.

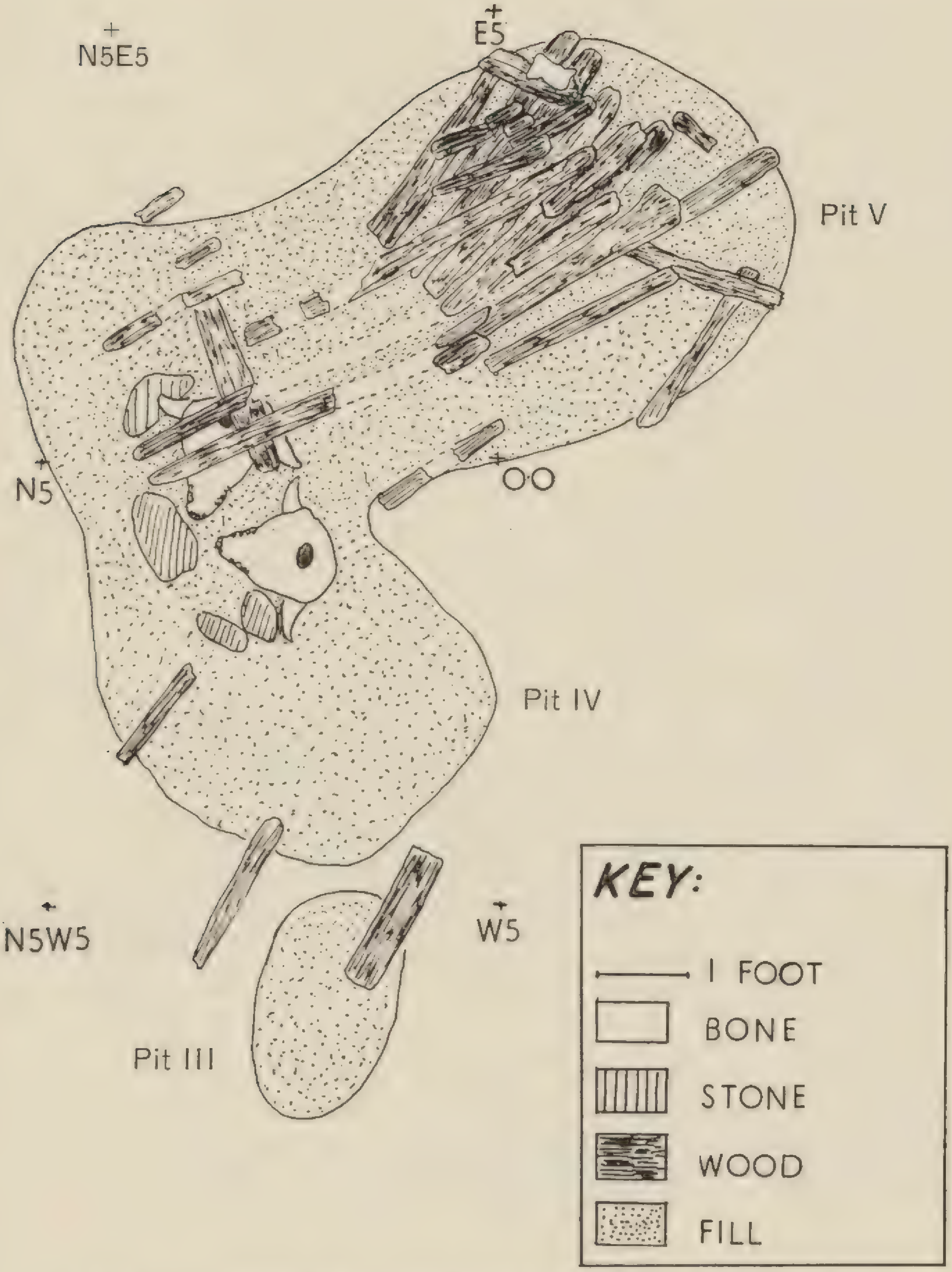

Figure 5. The covering of the burial pits in the centre of the Stott mound.

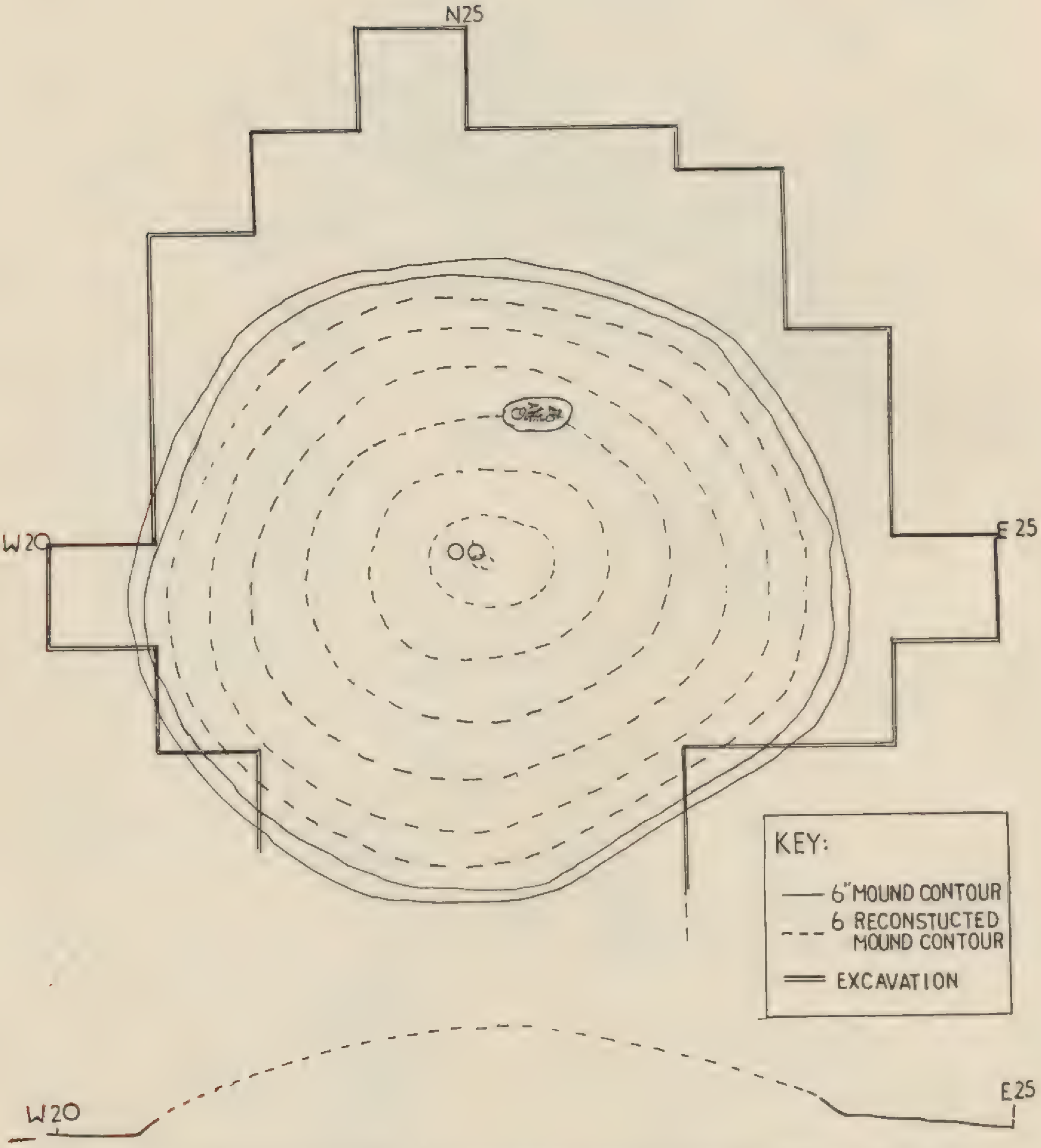

Figure 6. Reconstruction of the original Stott mound showing intrusive Pit VI with its burial.

THE STOTT VILLAGE SITE

Below the mound on the upper benches along the flanks of the Assiniboine Valley was a large village site. Dr. Ralph Bird had made rather extensive careful excavations in a section about 200 yards northeast of Mr. Stott's house. Since the small triangular end-scrapers, the two small projectile points, the two side-scrapers, and the blade fragments found in the mound were identical in type to those Bird found in the village, a test trench was dug in the village. It was felt that the materials from the village, plus those from the mound, would give a fairly complete picture of the material culture of the "mound builders" and yield information that would facilitate the tribal identification and cultural relationships of the people who had built the mound.

In this work a 5- by 20-foot trench was staked out running west from the southernmost square of Bird's excavations. The west end of this east-west trench was later connected with a 5- by 25-foot trench running north, roughly parallel with Bird's trench farther east. Datum depths were taken on the stakes of this trench, and a sketch map was made of the whole area (Figure 2A).

The digging of this L-shaped trench was somewhat governed by the circumstances and the advice of Dr. Bird, who had excavated in the area previously. The top humus, from 6 to 9 inches deep, which contained little cultural material, was removed by shovel and put through a half-inch mesh screen. Materials from this layer were sacked by square and called the top level. Below the humus was a compact layer of buffalo bone, with animal bone and artifacts between 6 to 14 inches thick. The bone was so compact that the first effort to remove it by trowel met with failure. After some experimenting, it was decided to break off vertical chunks of the bone layer and shovel the material through a screen. Profiles were drawn at every 5 feet, and features were noted. Materials from the bone layer were sacked by square and called the lower level. In digging the bone layer, three areas about two feet in diameter showed considerable burning and were considered to be hearths. One of these hearths was in the lower 3 inches of the bone layer with its centre near the easternmost end of the trench. A second hearth was in the lower one-third of the burnt area at E 8 N 1·5, whereas the other was on the top of bone layer at E 14. Artifacts were intermingled with the bone with no semblance of occupation layers or concentrations.

Dr. Bird generously lent the artifacts he had found so that they could be studied along with what was uncovered. These analyses are presented in two parts: The first is a description of the artifacts in terms of artifact types with the purpose of showing the spatial and temporal relationships of the people who occupied the Stott Site; the second section is a reconstruction of the culture of the peoples who occupied this site and a consideration of the problem of Manitoba Mounds.

The Artifact Descriptions

In describing the artifacts, an attempt has been made to classify them into types. A type is defined as "a group of objects having inter-related similar features which have temporal and spatial significance."[1] In setting up types of the Stott Site materials, they are compared with similar materials from the upper levels of the Avery Lake Site dug by Vickers, and with similar artifacts from level 5 of the stratified Lockport Site dug by the writer in 1950. No doubt, as more materials are excavated in Manitoba, the types here established will have to be defined and redefined. However, be that as it may, the types here mentioned are time markers (index fossils) for a portion of Manitoba prehistory, and they may in part indicate spatial or tribal difference at one time-period.

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[1] Ritchie and MacNeish, 1949, p. 98.

In the following descriptions the types are grouped under various artifact headings for convenience. The actual uses of the types and function of the types or complexes of types will be mentioned in the section on historical reconstruction.

POTTERY

In studying the pottery, the 846 sherds from the Stott Site were compared with the 953 similar sherds (out of the total of 2,591) from the Lockport Site, most of which came from the upper levels of Hlady's 1947 excavation in the 10- by 10-foot trench and from level 5 of the author's excavation in 1951. On the basis of this comparison it was found that of the five pottery types of the Manitoba Corded Ware, four of them appeared at the Stott Site.

Manitoba Corded Ware—Eight hundred and thirty-five sherds of this were examined from the Stott Site.

PASTE:

Temper: Granite, mica, feldspar, quartz, quartzite, and small pebbles, ranging in size from ·025 to 3 mm. in diameter with average about ·05 mm., occur as temper in the order mentioned. Temper occurs in medium amounts, 375 cubic mm. of crushed pottery giving 90 pieces of temper.

Texture: Slightly coarse but characterized by a very laminated and porous paste.

Colour: Exterior surface from light ochraceous salmon to black with most being deep mousey-grey, less range on interior with a very few salmon and many black or blackish brown. In cross-section, interiors are black or mousey-grey. On many sherds the same colour occurs from surface to surface while some have only a very slight change at the surfaces.

Hardness: About 3.

Thickness: Generally speaking, rim and neck sherds are much thicker than body sherds, so they are considered separately. Body sherds range from 2 to 8·5 mm. with the average being about 4 mm. (Based on a sample of fifty random sherds). Rim sherds at the lip range in thickness from 6 to 13 mm. with an average of 9 mm.

Decoration: Decoration is usually by the impressing of cord(thong)-wrapped stick or the edge of a cord (thong)-wrapped paddle on the wet clay. The cords (or thongs) range in width from ·025 mm. to 1·5 mm., the average being about 1 mm., and are usually spaced close together, never being more than 3 mm. apart. Various straight-line designs occur on the lip, inner rim, outer rim, and on the neck.

Surface Finish: Bodies of this type always bear cord-marking with vertical cord-marks running more or less parallel. The cords vary between 1 and 4 mm. in diameter, with average about 2 mm. The vertical impressions are between ·05 and 6 mm. apart, usually about 2 mm. The cords seem to be composed of one or two elements (usually the latter) and have been twisted counter-clockwise, though a few are clockwise. Just what the actual cord was composed of is difficult to determine; a few sherds show fibrous strand impression, but most of them do not. However, the latter may be due more to the method of impression and wetness of the clay rather than the presence or absence of fibrous string.

The cord impressions seem to have been made by the application of a cord-wrapped paddle. Sherds show small patches of a series of parallel cords continuing for some distance to other little patches with parallel cords at slightly different angles. The latter cords are not a continuation of the first set of cords. There are enough very large sherds to tell exactly the number of cords. On the basis of five of the largest sherds, it would appear that the cord encircled the paddle from ten to twenty times and that paddles were at least 2 inches wide.

Necks and rims of vessels usually appear to have been smooth or brushed before decoration was applied to them. Interior surfaces were wiped or smoothed with a horizontal motion.

Vessel Form: Only one pot and about 650 rim sherds of this ware have been examined. However, the rim sherds of this ware indicate that only one general vessel form is dominant.

Lips are always flattened and spread by pressure from above the lip. Most of the lips are at an acute angle to exterior surface of the rim.

Rims, generally speaking, thicken toward the lip and are very slightly outflaring or outsloping (Figures 1–10). Rims gradually blend into a fairly long cylindrical neck which ends abruptly at the body.

Judging from one pot and a few (5) large sherds, bodies seem to be ellipsoidal with rounded conical bases.

Manitoba Horizontal—One hundred and twenty-seven of this type were found at the Stott Site (Plate IV, 1 and 2).

Paste and Surface Finish: These are the same as Manitoba Corded Ware.

Decoration: This type is characterized by horizontal lines of cord-wrapped stick decoration around the neck. Fragments of these necks were very common (Design 1 of Figure 7 or Plate IV,1, 2). In a few cases (17), there was a band of short oblique cord-wrapped impressions at the junction of the neck and body below the horizontal lines (Design 2). Rim fragments show that above the horizontal lines on the neck there is usually a band of oblique cord-wrapped stick impressions on the outer rim, lip, and inner rim (Designs 3 to 9 of Figure 7). A few small rim sherds show only the oblique cord-wrapped stick band (Designs 11 and 12, Figure 7), but it is probable that even these had horizontal impressions on the neck. These decorated sherds usually have circular punctates one-eighth to one-half inch in diameter encircling the neck from a half to two inches apart.

Vessel Form: Described under Manitoba Corded Ware.

Diagnostics of the Type: Oblique rows of cord-wrapped stick designs on the under rim, thickened top and outer rim with horizontal lines of cord-wrapped stick and with circular punctates on the neck above an elongated globular body covered with cord-marking.

Temporal Range: This type appears in late prehistoric and early historic times.

Geographical Range: This type is common in northern Minnesota in the Black Duck focus, as well as in southwesternmost Ontario, and survey indicates it occurs in most of southern Manitoba and southeast Saskatchewan. It was very common in level 5 of the Lockport 1951 excavation and the upper levels of Avery Lake.

Manitoba Brushed—Only fifteen sherds of this type appeared at the Stott Site (Plate IV, No. 3).

Paste and Surface Finish: Described under Manitoba Corded Ware.

Decoration: This type is characterized by vertical lines of brushing on the neck. Study of these brushings reveals that they were probably made by wiping the edge of cord-wrapped paddle or stick against the neck. On the rims and lip there are usually short parallel oblique impressions of a cord-wrapped stick. Sometimes there are circular punctates on the neck.

Vessel Form: Described under Manitoba Corded Ware.

Diagnosis of Type: Brushed necked vessels with cord-wrapped stick decorations on thickened lips and rims above elongated globular cord-marked bodies.

Temporal Range: This type occurs in late prehistoric and early historic times. The type is slightly more prevalent at the Stott Site than at either Lockport or the Avery Lake Site.

Geographical Range: Same as Manitoba Horizontal.

Stott Triangular—Only thirteen sherds of this type occurred (Plate IV, 4, 5).

Paste and Surface Finish: Same as described under Manitoba Corded Ware.

Decoration: This type is only decorated on the outer rim and neck. Decoration on the exterior rim is by a band of short vertical incised lines about half an inch long and spaced about one-quarter inch apart. On the neck the decoration is made by a cord- or thong-wrapped stick.

Plasticine impressions of these neck decorations reveal that none of the strands (about 5 mm. wide) wrapped around the stick have been twisted. Thus, it is concluded that there are probably very thin thongs of gut or string wrapped around the stick—not true cord.

Decoration on the neck consists of a zone of horizontal parallel lines of thong-wrapped stick impressions which are between two or four triangles outlined by thong-wrapped stick impressions.

Vessel Form: Same as Manitoba Corded Ware.

Diagnosis of the Type: The decorations described above characterize the type.

Temporal Range: So far this type has been found only at the Stott Site.

Geographical Range: It does not occur at Avery Lake or the Lockport Sites.

Stott Noded—Seventeen sherds of this type occurred at the Stott Site (Plate IV, No. 6).

Paste and Surface Finish: Described under Manitoba Corded Ware.

Decoration: The decoration is very much the same as that of Manitoba Horizontal except for one factor. The difference is that this pottery type, instead of having exterior punctates, has exterior nodes.

Vessel Form: Here also it differs from many of the other types of Manitoba Corded Ware in that the lips are not flattened and the rims do not expand very greatly nearing the lip.

Diagnosis of the Type: Oblique cord-wrapped stick decorations are on the rounded lips and on the straight parallel inner and outer rims, while necks bear horizontal lines of cord-wrapped stick decorations and nodes.

Temporal and Geographical Range: This type is mainly confined to the Stott Site and did not occur in the Lockport excavations. However, a few sherds of this type are known from surface collections from sites in southern Manitoba.

Regina Heavy Corded Ware—Fifteen sherds of this ware occurred at the Stott Site (Plate IV, 7). This ware was absent at the Avery Lake or Lockport excavations. Surface collections, however, indicate this kind of ware to be fairly common in southern Saskatchewan;[1] and eventually, upon the basis of comparisons of sherds from excavations in that area, it should be divisible into a number of types.

PASTE:

Temper: Granite, quartz, and quartzite occur as temper and range from 1 to 3 mm. in diameter. Temper is fairly rare—only 30 pieces occurring in 375 cu. mm. of crushed pottery.

Texture: The cross-sections of sherds show them to be laminated and granular.

Colour: Most of them are mousey-grey on the exterior, while those on the interior are characteristically black.

Hardness: 2 to 3.

Thickness: Sherds range in thickness from 6 to 14 mm. with the average 9 mm.

Surface Finish: The exteriors of these sherds are always cord-marked. The markings run vertically and are closely spaced. The individual cords are usually about 2 mm. wide.

Decoration: On the lip, the interior rim and the exterior rim of ten of the sherds are wide, oblique, cord-wrapped stick impressions; two sherds have notches at the junction of rim and lip while eleven are undecorated. All, however, have circular punctates encircling the neck.

Vessel Form: Characteristically, the lips are flat, and the rims and necks slope inward from a globular body.

Aberrant Sherds—Fifteen sherds are totally different from the others at the site and are considered aberrant or trade sherds. Six of these sherds have notched lips and cord-marked bodies and are very similar to those found at the Belmont midden near Belmont, Manitoba[2] (Plate IV, 9). Two sherds have wide incised lines on them and look like possible Upper Mississippi sherds like those found at the Cambria Site in Minnesota[3] (Plate IV, 11). Two sherds bear fabric impressions like the historic Cree pottery. One outflaring rim sherd with a notched lip has cord-impressed decorations on the neck. This looks like a Mandan sherd[4] (Plate IV, 10). There are three vertical rim sherds with smooth necks with circular punctates on them, and lips with cord-wrapped stick decoration. Sherds similar to these have been found on the Belmont midden (Plate IV, 8). A final vertical-necked sherd has a series of irregular linear punctates on it (Plate IV, 12). It is different from anything else so far discovered.

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[1] Boyd Wettlaufer, survey notes and material deposited in the files of the National Museum of Canada.

[2] Sherds from the Belmont midden are in the collection of Christopher Vickers of Baldar, Man.

[3] Wilford, 1945.

[4] Will and Hecker, 1944.

TABLE I

Listing of Ceramic Features

MANITOBA CORDED WARE				835
Body sherds			643	
1. Wide cord impressions	376			
2. Narrow cord impressions	163			
3. Smoothed over cord impressions	104			
Decorated sherds by cord-wrapped stick			192	
Manitoba Horizontal Type		127		
1. Des. 1 of fig. 7	46			
2. Des. 2 of fig. 7	17			
3. Des. 3 of fig. 7	1			
4. Des. 4 of fig. 7	2			
5. Des. 4 of fig. 7, rim 1 of fig. 8	5			
6. Des. 4 of fig. 7, rim 2 of fig. 8	2			
7. Des. 4 of fig. 7, rim 3 of fig. 8	1			
8. Des. 4 of fig. 7, rim 4 of fig. 8	1			
9. Des. 4 of fig. 7, rim 5 of fig. 8	1			
10. Des. 4 of fig. 7, rim 6 of fig. 8	1			
11. Des. 5 of fig. 7, rim 5 of fig .8	1			
12. Des. 3 of fig. 7, rim 1 of fig. 8	2			
13. Des. 3 of fig. 7, rim 2 of fig. 8	2			
14. Des. 3 of fig. 7, rim 3 of fig. 8	2			
15. Des. 3 of fig. 7, rim 4 of fig. 8	2			
16. Des. 3 of fig. 7, rim 5 of fig. 8	5			
17. Des. 3 of fig. 7, rim 7 of fig. 8	2			
18. Des. 3 of fig. 7, rim 8 of fig. 8	3			
19. Des. 3 of fig. 7, rim 9 of fig. 8	1			
20. Des. 3 of fig. 7, rim 13 of fig. 8	1			
21. Des. 6 of fig. 7, rim 8 of fig. 8	1			
22. Des. 7 of fig. 7, rim 7 of fig. 8	7			
23. Des. 8 of fig. 7, rim 1 of fig. 8	5			
24. Des. 9 of fig. 7, rim 2 of fig. 8	1			
25. Des. 10 of fig. 7, rim 7 of fig. 8	5			
26. Des. 10 of fig. 7, rim 3 of fig. 8	1			
27. Des. 11 of fig. 7, rim 1 of fig. 8	1			
28. Des. 11 of fig. 7, rim 3 of fig. 8	1			
Manitoba Brushed		15		
1. Brushed neck sherds	7			
2. Des. 10 of fig. 7, rim 4 of fig. 8	2			
3. Des. 10 of fig. 7, rim 7 of fig. 8	1			
4. Des. 10 of fig. 7, rim 9 of fig. 8	1			
5. Des. 11 of fig. 7, rim 2 of fig. 8	1			
6. Des. 11 of fig. 7, rim 7 of fig. 8	1			
7. Des. 11 of fig. 7, rim 8 of fig. 8	1			
8. Des. 12 of fig. 7, rim 2 of fig. 8	1			
Stott Triangular		13		
1. Des. 1 of fig. 7	1			
2. Des. 13 of fig. 7	1			
3. Des. 14 of fig. 7	2			
4. Des. 13 of fig. 7, rim 10 of fig. 8	5			
5. Des. 14 of fig. 7, rim 1 of fig. 8	1			
6. Des. 14 of fig. 7, rim 10 of fig. 8	1			
7. Des. 16 of fig. 7, rim 1 of fig. 8	1			
8. Des. 16 of fig. 7, rim 10 of fig. 8	1			

TABLE I—*Concluded*

Listing of Ceramic Features—Concluded

Manitoba Corded Ware—*Concluded*				
Stott Noded	......	17		
1. Des. 1 of fig. 7, rim 10 of fig. 8	3			
2. Des. 5 of fig. 7, rim 13 of fig. 8	1			
3. Des. 6 of fig. 7, rim 10 of fig. 8	5			
4. Des. 6 of fig. 7, rim 13 of fig. 8	2			
5. Des. 17 of fig. 7, rim 1 of fig. 8	4			
6. Des. 17 of fig. 7, rim 8 of fig. 8	1			
7. Des. 17 of fig. 7, rim 10 of fig. 8	1			
Regina Ware	......	......	12	
1. Des. 18 of fig. 7, rim 13 of fig. 8	6			
2. Des. 18 of fig. 7, rim 14 of fig. 8	1			
3. Des. 19 of fig. 7, rim 14 of fig. 8	3			
4. Des. 20 of fig. 7, rim 15 of fig. 8	2			
Aberrant or Trade Sherds	......	......	15	
Belmont midden sherds	......	6		
Cambria Incised	......	2		
Selkirk (Cree) Fabric Impressed	......	2		
Mandan-like sherd	......	1		
Smoothed Neck sherds	......	3		
Punched Neck sherd	......	1		
Total Sherds From Stott Village Excavations	......	......	......	862

PROJECTILE POINTS

One hundred and forty-five projectile points or fragments thereof were found in the lower bison bone layer. On the basis of comparison with thirteen points from levels 1 to 5 at Lockport, and fifty-four from the upper levels of the Avery Lake Site, four types have been established.

Plains Triangular—Twenty points of this type occurred (Plate V, 1,2).

These points are triangular in outline with slightly excurvate sides and straight to excurvate bases. They range in length from 14 to 32 mm., in width from 11 to 21 mm., and in thickness from 1 to 6 mm. The average is about 24 mm. long, 16 mm. wide, and 3 mm. thick.

The points seem to have been made from thin flakes and fashioned into shape by pressure flaking along their edges. Many of them have flat, central surfaces with a single or a few flake scars on them.

Temporarily, they seem to be mainly in late prehistoric times, and the type is on the wane at historic times in Manitoba. Geographically, they appear to be widespread in Manitoba and are similar in type to, or the same type as, those present on sites of the early historic horizon in most of North America.

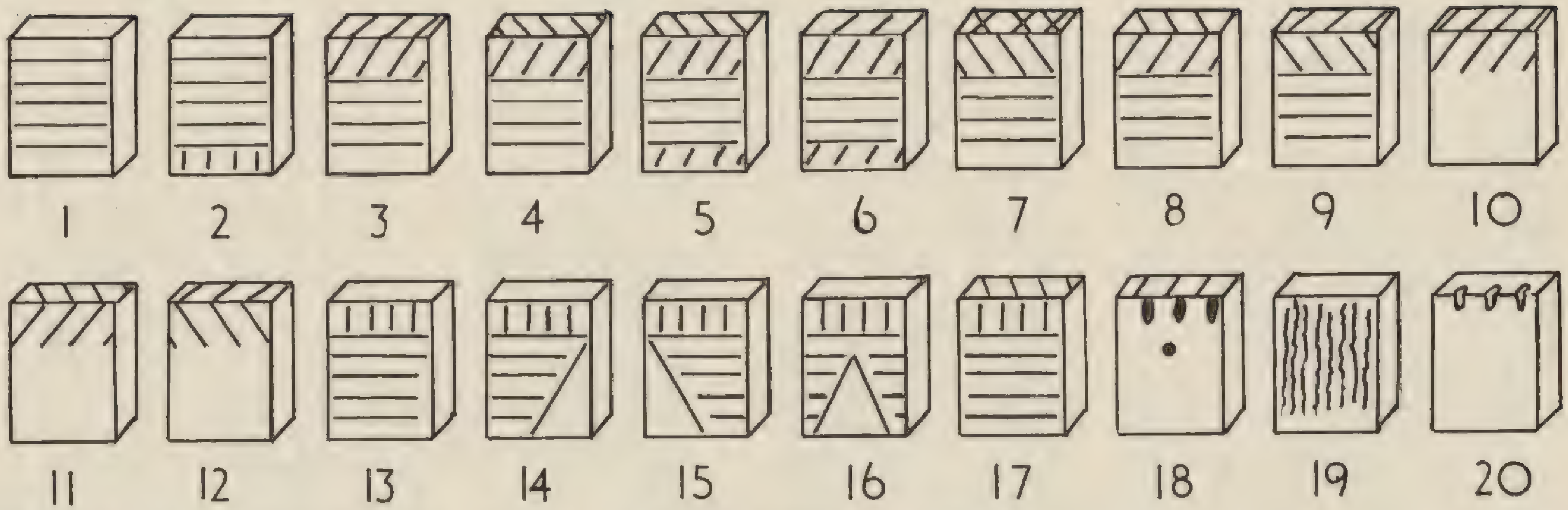

FIGURE-7. DESIGNS ON THE LIP, RIM AND NECK

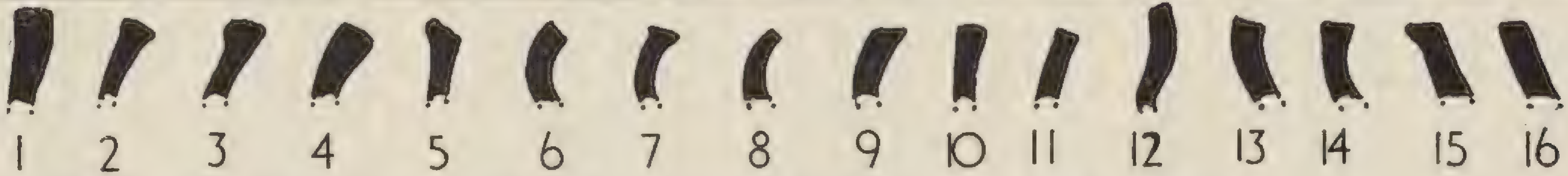

FIGURE-8. RIM CROSS-SECTIONS, EXTERIORS TO THE RIGHT

Prairie Side-notched—Fifty-nine of this type occurred (Plate V, 3).

These points are roughly triangular in outline but have small side-notches just above their bases. They range from 19 mm. to 33 mm. in length, from 15 to 30 mm. in width, and are between 2 and 6 mm. in maximum thickness. An average point would be about 26 mm. long, 20 mm. wide, and 3 mm. thick. The small side-notch is between 1 and 4 mm. above the base, and is from 2 to 4 mm. deep.

The points are made from thin flakes, but both their surfaces usually have been reworked by lateral pressure flaking and the edges have been retouched.

Temporal and spatial ranges are about the same as those of Plains Triangular.

Plains Side-notched—Twenty-seven of these points occurred (Plate V, 4).

The points are also rough equilateral triangles in outline with small side notches. They range in length from 10 to 18 mm., in width from 8 to 16 mm., and are usually about 2 mm. thick. They are made from thin flakes that have been retouched on both surfaces as well as along their edges.

These points graduate into the Prairie Side-notched types and are probably derived from them. At both Avery Lake and level 5 of Lockport, they are very rare. However, in levels 1 and 2 of Lockport and in the historic Cree Site of Alexander's Point they are the dominant type. Generally speaking, survey indicates they are widespread in Manitoba at historic times.

Stott Corner-notched—Twelve of this type occurred (Plate V, 5).

They have tapering excurvate sides, small corner-notches, and an excurvate base. They range from 20 to 30 mm. in length; their maximum width just above the notches ranges from 10 to 16 mm., and they are usually about 2 mm. thick. They are made from thin flakes usually retouched on both surfaces and along the edges.

This type of point occurs at the Stott Site and in a few surface collections in southwest Manitoba. It seems to be present mainly on the early historic horizon.

SCRAPERS

Flat End Scraper—Thirty-five of this type occurred (Plate V, 9, 10).

These are rough equilateral triangles in outline with excurvate sides. They range in length from 12 to 32 mm., in width from 10 to 30 mm., and maximum thickness falls between 3 and 8 mm. Ventral sides are usually flat and represented by a single flake scar. Dorsal surfaces are usually fairly flat with from one to three flake scars on them. The cutting ends are usually very steep, almost vertical, and bear vertical retouching on them. The other edges are also retouched but not so steep, and there is a tendency for the points opposite the cutting end to be fairly thin.

Geographically, these scrapers are widespread in the Canadian plains and prairies. However, in both Lockport in level 5 and in the upper levels of the Avery Lake Sites, they are relatively rare as compared to the plano-convex end scrapers. Furthermore, in late prehistoric and historic Cree sites, they are the dominant type. It is believed this is a type that begins in late prehistoric times and reaches its greatest popularity in the early historic period.

Plano-Convex End Scraper—Twenty-two of these occurred in the bone layer (Plate V, 7, 8).

They average from oblong to roughly triangular in outline. In size they fall between 22 mm. and 40 mm. in length, and 20 to 28 mm. in maximum thickness. Ventral surfaces are flat or slightly concave and are represented by a single flake scar. Dorsal surfaces have steep, finely retouched cutting ends, while the rest of the surface is convex with fine retouching and tapering toward the end opposite the cutting edge.

Scrapers of this type are widespread in the Canadian plains and prairies. Both at the upper levels of Avery Lake and level 5 of Lockport, they were the dominant type, and they appear to be diminishing at the historic horizon.

Keeled End Scrapers—Two keeled end scrapers were found intermingled with the buffalo bones (Plate V, 6).

The larger of these is 62 mm. long, 21 mm. wide near the cutting end, and has a maximum thickness near the cutting end of 13 mm. The smaller one is 29 mm. long, 14 mm. wide, and 6 mm. thick. Both have a long tapering side and a convex scraping end. Both are made from a thick lamellar flake, have concave ventral surfaces, a keeled convex dorsal surface, retouching along their sides and steep retouching on their ends.

This type of scraper is relatively rare in Manitoba. One was found in the lowest pottery level of Lockport. They are more common with late pottery in Saskatchewan.

Flake Side Scrapers—Thirty-two flake side scrapers occurred.

These occur in a variety of shapes but are characteristically thin, between 1 and 6 mm., except one that is 11 mm. thick. Most of them have a more or less flat ventral surface and a very slightly convex dorsal surface with fine steep retouching along one excurvate edge. Four have steep retouching along two edges.

These are a very common type of artifact that has a wide spatial distribution and appears in many different time periods.

Hoe-like Scrapers—Two large artifacts of micaceous quartzite occurred with the buffalo bone (Plate V, 14).

One is only a large flat fragment with bifacial chipping along one side, but the other appears to be a complete artifact. The complete artifact is 163 mm. long, 97 mm. wide, and has a maximum thickness of about 30 mm. It is ovoid in outline with one end slightly more pointed than the other. Both surfaces along the entire edges have been percussion flaked, and the edges appear to be dulled, perhaps by wear.

Artifacts similar to these did not appear at levels 5 and 6 of Lockport, but one occurred in level 1 of Lockport (the prehistoric Cree horizon). They were present in the upper levels of the Avery Lake Site and occur in historic Cree sites. Generally speaking, in Canada they are most common in the Athapaskan speaking area but are fairly rare in the plains of Canada.

KNIVES

Semi-lunar Side Blades—Eight whole blades were present along with six possible fragments of this type in the lower cultural layer of the Stott Site (Plate V, 12 or 13).

They are all half-moon shaped in outline. They range from 58 to 75 mm. in length, from 17 to 30 mm. in maximum width at their midpoint, and are between 5 and 11 mm. in thickness. Both surfaces are chipped, and all edges are retouched.

These occurred in both the upper levels of the Lockport and the Avery Lake Sites in fair numbers, and seem to be a widespread late type in the Canadian plains.

Ovoid (End) Blades—Six fragments of ovoid blades with one pointed end occurred at the Stott Site (Plate V, 11).

The almost complete blade is 63 mm. long, and the width falls between 24 and 36 mm., while the thickness ranges from 5 to 12 mm. They are bifacial, are chipped, and have irregular pressure flaking along their edges on both sides.

They are a common type of blade which has a considerable temporal and spatial range.

FULL GROOVED AXES OR MAULS

(Plate V, 15).

Two occurred in the excavation, and F. Stott found a large number on the surface of the site. One of the excavated axes is 128 mm. long, 72 mm. wide, and 58 mm. thick. The second is 148 mm. long, 91 mm. wide, and 61 mm. thick. The first one weighs two and a half pounds while the second weighs three and a half pounds. They are usually made of glacial boulders, and their full grooves have been pecked out from around their centres. Both ends are usually flattened either by use or on purpose.

Such tools are widespread in the Canadian plains. They occur in the upper levels, both at Lockport and at Avery Lake. They do not seem to occur in the earliest ceramic horizons or in pre-pottery horizons in Manitoba.

HAMMER STONES

Pebble Hammer Stones—Fragments of five occurred in the Stott Site excavations.

All are made from ellipsoidal pebbles, and one or both of the narrower ends show pecking on them.

Such tools have little temporal or spatial significance as they occur at many sites in the Plains of many periods.

Anvil Stone—One pebble that Dr. Bird found in the excavation has a small depression pecked into one of its flatter surfaces.

None of these has been noted from other sites in Manitoba.

BONE TOOLS

Handles for End Scrapers—(Plate VI, 16).

Five fragments of handles for end scrapers and one whole specimen were in with the buffalo bone. All are made from bison ribs. The whole specimen is 142 mm. long, 20 mm. wide, and 7 mm. thick. The sides of the handles have been polished, and one end has been cut to a point and then polished to form a round end. The opposite end has been squared off and a hollow slot about half an inch deep for the stone end scraper has been gouged out of the interior section.

Handles for end scrapers were found in the upper levels of Avery Lake, and they appear at very late prehistoric sites in Saskatchewan. The presence of end scrapers in all the pottery levels of Lockport as well as the pre-pottery levels probably means that they may have a considerable temporal range.

Bone Flaker—(Plate VI, 13).

Dr. R. Bird found a single bone flaker in the lower cultural layer of the Stott Site. This object is made from a rib bone and is 90 mm. long, 19 mm. wide, and about 6 mm. thick. Its two sides have been polished, and its ends have dull points that have been polished.

Similar tools occurred in the upper levels of the Avery Lake and Lockport Sites.

Unilateral Barbed Points—(Plate VI, 14, 15).

On Dr. Bird's excavation of the Stott Site, he found two unilaterally barbed bone points. One has a single barb in evidence; the other shows two barbs on one side. One is 8 mm. wide and 6 mm. thick; the longer one is 14 mm. wide and 6 mm. thick.

Similar harpoons occurred in both the upper levels of the Avery Lake and the Lockport Sites as well as in a historic Cree site. They do not seem to appear in the earliest pottery horizon or in pre-pottery horizons in Manitoba.

Bone Awls—(Plate VI, 11, 12).

Bone awls were found made from splinters of bone that had been ground to a conical point. These are common objects in Manitoba and do not seem to have any great temporal significance.

Curved Bone Hook—(Plate VI, 10).

Dr. Bird found a single curved hook-like object of bone made from a rib and polished to a point on one end.

Beaver Tooth Gouges

Fragments of beaver teeth were found that had been ground artificially at an obtuse angle to the normal wear caused by the animal. This indicates that the occupants had used these teeth as gouges. Similar ones appear in the upper levels of the Lockport Site and Avery Lake and the historic Cree Alexander's Point Site. They did not occur in the lower levels of Lockport or at the pre-pottery Laxter Site.

Bone Flesher—(Plate VI, 9).

In the buffalo bone level at the Stott Site, Dr. Bird found a bone fleshing tool. This tool is made from a deer leg bone which has been cut and polished to a gouge-like cutting edge. Hlady and Hecker found part of one in the upper levels of the Lockport Site, and they appeared on the top levels of the Avery Lake Site.

Wolf or Dog Canine Pendant—(Plate VI, 6).

One small dog or wolf canine figure was pierced at its base to form a pendant. I know of no similar objects from Manitoba.

Rectangular Bone Pendants—(Plate VI, 7, 8).

Dr. Bird found two rectangular bone pendants in his excavations at the Stott Site. The larger one, broken on one end, is made from a rib 14 mm. wide and 2 mm. thick. One end has a cut round hole. Extending longitudinally in the centre of the pendant is a groove that has small nicks along its edges. The other pendant, which might have been a needle, is only about 7 mm. wide and 1 mm. thick. One of its ends seems to be broken, while the other end is cut at right angles to the sides. Just below the cut end is a small round cut hole.

Bone Whistle—(Plate VI, 1).

One bird-bone whistle occurred under the head of burial XV-A-101 in pit 4 in the mound. It is 152 mm. long and about 25 mm. in diameter. Twenty millimetres from one end, a large hole, oblong in shape, had been cut through its surface to its hollow interior. This is about 22 mm. long and 14 mm. wide.

Similar bone whistles are found in the burial mounds of Manitoba. Since they are absent from the village sites, it is probable that such tools are connected with burial beliefs or ceremonies.

SHELL ARTIFACTS

Columella Shell Beads—(Plate VI, 3, 4).

The larger tubular columella bead occurred at the neck of burial XV-A-104 in the intrusive pit 6. The other was at the head of burial XV-A-106 in pit 4. The larger tubular bead is 28 mm. long, has a diameter of about 12 mm., and the diameter of its hole is 4 mm. The other is 19 mm. long and 7 mm. in diameter, and its hole is 2 mm. in diameter. Both are made from the central twisted spine of the conch shell that had been ground to a cylindrical form and cut into sections, and then a longitudinal hole had been drilled through it.

The artifacts occur in a number of Manitoba burial mounds but are absent in village sites.

Oliva Shell Beads—(Plate VI, 5).

Six oliva shell beads occurred in the neck region of burial XV-A-104 in intrusive pit 6. The small (8 mm. long) oliva shell beads have been pierced near their apexes.

Similar beads were in other mounds in Manitoba but are absent in village sites.

Clam Shell Spoon

Under the head of burial XV-A-101 in pit 4 was a large mollusc shell that had evidence of wear along one edge. Similar spoons occur in mounds.

Tubular Copper Bead—(Plate VI, 2).

Dr. Bird found this very important artifact in the centre of the buffalo bone layer; there can be little doubt about its being contemporaneous with the deposition of the buffalo bones. The object is of rolled copper, being 62 mm. long and having a maximum width of 6½ mm. On the basis of an analysis of the copper, it has been determined to be probably of European origin. Vickers and Bird have pointed out that such an object would date the Stott Site as being in the seventeenth century, thus suggesting that the Assiniboine were the occupants of that site.

ANIMAL BONE

It has not been possible to have a zoologist identify as to species the bone that occurred at the Stott Site. However, some cursory identification worth noting has been undertaken. The predominant animal bone found in both the mound and the village site is that of the buffalo or bison. This makes up about ninety-nine per cent of all the bone. Besides the buffalo, the remains of other animals occurred, namely, dog, wolf, bear, deer, beaver, wapiti, coyote, lynx, skunk, snow-shoe rabbit (varying hare), squirrel, and rodents. Also present were fish bones, turtle shells, bird bones, and clam shells.

COMPARISON

At the present time there is not a great deal of excavated materials from Manitoba for comparison. In terms of village sites, there are only the upper levels of the Avery Lake Site,[1] the upper levels of the Lockport Site in Manitoba[2], and materials of the Blackduck focus of northern Minnesota[3] that are similar to the Stott village. Thanks to Nickerson's field notes, photographs, and specimens deposited in the National Museum of Canada, from the Starr Mounds A and B, the Sourisford Mounds H, the Snyder Mound R, the Moore Mounds B and C, the Lone Mound, McGorman Mound, the Riverview Mound, and the Sims Mound,[4] there is considerable more material for comparison with the Stott Mound. There are also available the materials from the Rosser Mound that Rand, Shaw, and Stokes excavated.[5]

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[1] Excavated by Vickers.

[2] Hlady and Hecker excavated on this site in 1947. Also, further excavations in this site in 1951 were made by the author, and these were of use in making comparisons.

[3] Wilford, 1941.

[4] Nickerson, 1914.

[5] Rand, 1941.

TABLE II

A Comparision of the Stott Village Site Traits with Related Village Materials

Village Traits	Stott Village	Upper levels of Avery Lake village	Upper (5) levels of Lockport village	Blackduck Lake Village
1. Hunting economy	x	x	x	x
2. Manitoba Corded Ware	835	x	234	x
Manitoba Horizontal	127	x	22	x
Manitoba Brushed	15	x	4	x
Stott Triangular	13			
Stott Noded	17	x		
Manitoba Herringbone		x	18	x
3. Plains Triangular Pts	20	15	6	x
4. Prairie Side-notch Pts	59	36	4	x
5. Plains Side-notch Pts	27	3	2	
6. Stott Corner-notch Pts	12	2		
7. Flat end scraper	35	1	2	x
8. Plano-convex end scraper	22	47	8	x
9. Keeled end scraper	2	3		
10. Flake side scraper	32	56	6	x
11. Hoe-like scraper	2	2		
12. Semi-lunar side blade	14	15	2	x
13. Ovoid blades	6	13	1	x
14. Full grooved maul	2	2	?	x
15. Pebble hammerstone	5	15	3	x
16. Anvil stones	1	2		
17. Bone handle for end scraper	6	x		
18. Bone flaker	1	4	1	x
19. Unilateral barbed point	2	3	1	x
20. Bone awls	2	3	2	x
21. Curved bone hook	1			
22. Beaver tooth gouge	4	5	2	x
23. Bone flesher	1	3	4	x
24. Canine pendant	1	1		
25. Rectangular bone pendant	2			
26. Phlange for cup-and-pin game		1		
27. Graving tools		5		
28. Full grooved axe		1		

A comparison of the Stott village site with the upper levels of Avery Lake, with level 5 of Lockport, and with Blackduck reveals a number of distinctive traits held in common (Table II). These traits are: Manitoba Ware pottery; plains triangular, prairie side-notched and plains side-notched projectile points; small flat and plano-convex end scrapers; semi-lunar side blades; unilateral multi-barbed bone points; bone handles for end scrapers; bone flaking tools; beaver tooth gouges, and long bone fleshers. A number of general traits occur at these four sites, such as flake side scrapers, ovoid beads, bone awls, and pebble hammerstones. As may be seen from Table II, there are also a number of traits that appear at two or more of these sites but very few items that are distinctive of just one of these sites. On the basis of the above evidence, I would consider that all the sites here compared are genetically connected and may be classified in the Headwater Lake Aspect. The Stott site and the upper levels of Avery Lake are almost identical, even to pottery. I would classify them in the Manitoba Focus. Since the components of Avery Lake, Lockport, and Blackduck are all prehistoric and the Stott Site had a single piece of European copper, it seems valid to conclude that the Stott Site is a somewhat later development from an artifact complex like that found on these other sites mentioned above. It is perhaps significant to note that, at Lockport, materials like those from the Stott Site were stratigraphically under prehistoric Cree materials. This fact will be referred to later.

In Table III are compared the traits of the Stott Mound with those found in various other mounds in Manitoba. There appear to be a number of distinct similarities in these mounds. All are low (1 to 3 feet) and relatively wide in diameter (35 to 70 feet), and have been built on old occupation levels. They have deep, steep-sided burial pits containing bundle burials or flexed burials in a sitting position. The burial pits seem to have been always roofed over with logs, and the burials are usually associated with a few grave goods that are assignable to the Manitoba Focus. As may be seen from the chart, there are some differences between the burials, but they are relatively few. These comparisons are interpreted as indicating that all these mounds show a relationship and were probably made by the same group. It might be added that a cursory study of the skulls from the mounds reveals a similar physical type, and it is hoped that eventually an anthropometric study of them will be undertaken to determine just how similar they actually are. Admittedly there are some differences between the features of the burial mounds, and these discrepancies may be due to temporal differences. Only the digging of more mounds associated with villages and a more accurate method of determining the age of mounds can prove this.

A comparison of the Stott mound and related mound burial traits with the earliest historic account of Assiniboine burial practices is most significant. Alexander Henry (the elder), writing in 1776 of the Assiniboine burial practices, made the following statement: If the death occurs during the winter "it is everywhere rested on a scaffold, out of the reach of beasts of prey. The grave [is] made of a circular [cylindrical] form, about five feet deep and lined with bark of birch, or some other tree or with skins. A seat is prepared, and the body is placed in a sitting position . . . The body and its accompaniments are covered with bark, the bark with logs; and the logs with earth."[1] Putting Henry's burial description of Assiniboine burial practices into modern archæological terms, the Assiniboine burial traits are as follows: Bundle or flexed sitting position burials are placed in deep, steep-side burial pits. The burial is covered with logs, and the pits are roofed with logs, and a small low mound is built over the logs. As is perhaps obvious, these burial traits recorded by Henry for the Assiniboine are identical to those of the mounds of the Manitoba Focus. Thus, the Manitoba mound builders may be tentatively identified as being Assiniboine. Again it must be mentioned that low headed meso-cephalic skulls found in the mounds reveal them to have characteristics that George Neumann would consider diagnostic of the Assiniboine. Also it should be stressed that an anthropometric study of the Manitoba "mound builders" is very necessary.

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[1] Henry, 1809, pp. 303-304.

TABLE III

Occurrence of Cultural Traits and Features in Manitoba Mounds

—.-	Stott Mound				Lone Mound	Sims Linear Mound			Moore Mound B	Star Mound A							Snyder Mound R	Rosser Mound		Snow-flake Mound B	River-view Mound	McGorman Mound		Souris-ford Mound H	Moore Mound C
1. Mounds on bluffs		x			x		x		x				x				x		x	x	x		x	x	x
2. Mounds on occupation surface		x			x		x		x				x				x		?	x	x		x	x	x
3. Fireplace associated with burials		2			1		3		1				5				1		?						
4. Number of central burial pits		3			1		3		1				7				1		2	1	1		2	1	1
Designations of burial pits	3	4	5	6	1	S.E.	N.W.	C.	1	A	B	C	D	E	F	G	1	1	2	1	1	1	2	1	1
5. *Pit form:* cylindrical			1				1	1	1	1			1		?	?	1	1	1		1				
6. conical	1															1									
7. bucket-shaped		1			1						1	1		1								1			
8. sub-conoidal				1		1									1					1			1	1	?
9. *Position of burials:* bundle	dog	1	2		1		3	3	1	2			1	1		1		2		1	2	2		1	2
10. (seated) flexed		1	2	1	1	2	5	4	1	2	1	1					3	?	1		?				1
11. partial-skull							3					1				1	1			1					
12. limbs			2				2		1																1
13. others						x			x														1		
14. *Burial Associations:* red ochre		x	x		x			x	x	x	x					x	x	x	x		x				
15. Yellowish ochre or powder			x					x																	
16. Unio shell spoon		1			1			1	1							1	3	2		1?	1			1	
17. Columella bead		1		1		2		2		1								1		7					
18. Bird bone whistle		1																3	1	0					
19. Shell pendant					1	1	1	1													1				
20. Plains Triangular projectile point			1		9											1		1	1						
21. Oliva shell beads				6	1	27 rings																		1	
22. Small burial clay pot									1								1							1	
23. Bone awl																		2		1					
24. Bone arm band																						2		1	
25. Bone horn-like object																								1	
26. Full grooved maul																								0	1
27. Copper bead																								1	1
28. Square stone plaque																	1							0	
29. Tubular stone pipe																		2							
30. Unilateral multi-barbed bone point																		1							
31. *Pit cover:* Cedar or oak poles	x	x	x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	?	x	x	x	x	
32. boulders		x						x		x	x		x	x			x	x	x	x					
33. bark		x			?	x	x	x	?	?	?	?	?	?	?	?	x	x	x						
34. buffalo skulls		x							x								x					x			
35. puddled clay	x	x	x				x	x	?								?								
36. *Intrusive burials*				1																					2
37. *Mound shape:* Circular		x			x	x	x		x								x		x	x				x	x
38. Oval													x								x		x		
39. Linear								x																	
40. Size: Height		3′			1′	2′	2′	1′	1′				4′				2½′		4′	1′	2½′		2′	2′	2′
41. Length		35′			30′	25′	35′	170′	29′				140′				35′		60′	50′	41′		40′	40′	41′
42. Width		35′			30′	25′	35′	12′	27′				70′				35′		60′	50′	35′		25′	38′	40′

HISTORICAL RECONSTRUCTION

Any reconstruction of the life of the past from archæological data must draw heavily on ethnographic information. Such a reconstruction contains a series of inferences drawn from studies and descriptions of living primitive peoples. If the archæological assemblage can be dated and connected with any particular tribe, then the inferences about the excavated materials, based upon knowledge of that particular tribe, have a much greater probability of being valid.

Any tribal identification of the Stott Site is intimately connected with the age of the materials. Therefore, a consideration of the age of the Stott Site must be undertaken first. For the present, determination of the age of the site must be based upon the finding of the tubular bead made of European copper. It is hoped that eventually dendrochronology (employing the cedar from the mounds) or analysis by the radiocarbon method can also be brought to bear on this subject. Vickers and Bird have concluded, on the basis of a study of the copper bead, that the Stott Site was occupied between 1610 and 1682.[1] They argue that, since Henry Hudson's trip to Hudson Bay (James Bay) in 1610 represents the first European contact anywhere near the Stott Site, the bead cannot be before that date.[2] Furthermore, they note that the Assiniboine were having considerable trade with the Europeans after 1682,[3] and since the Stott Site has only a single trade object, they believe it is very unlikely that the Stott Site is after that date; otherwise more trade goods would have been found.

This brings up the question of who were at the Stott Site at that time. Here again, though there is no direct proof concerning the actual habitants, there are three kinds of indirect evidence. The Stott Site in 1730–1740, on the basis of the La Vérendrye journals and maps, appears to be in definite Assiniboine territory.[4] At an earlier time the region was not so well known, but Kelsey, in 1690, though he seems to have been well north of Brandon, saw only Assiniboine in the area just west of Lake Winnipeg, and it can be assumed that the Assiniboine were probably in the Stott site region.[5] Thus, it is possible that the Stott Site was in Assiniboine territory before Kelsey, from 1610 to 1682, and that the people at the site were Assiniboine. The second kind of evidence is perhaps more conclusive. In the area of Ft. La Reine at the junction of Portage Creek and the Assiniboine River, Fred Thompson of Portage la Prairie, Boyd Wettlaufer of Regina, Sask., and the writer have collected artifacts from the surface. All these artifacts are identical with those found at the Stott Site. Fort La Reine was built by La Vérendrye for the Assiniboine, so it seems likely that both the artifacts from around the Fort and the similar ones from the Stott Site were made by the Assiniboine.

Similarity between the Assiniboine burial practices recorded by Henry, the elder, and the burial practices at the Stott mound have previously been mentioned as evidence that the Stott mound was built by the Assiniboine. The evidence at the Stott village site of a number of bison "kills", the special burial (or sacrifice) of a dog in the mound, and the finding of a long bone "flesher" in the village refuse are further resemblances between the Assiniboine and the people at the Stott Site. These resemblances may indicate that both were one and the same tribe.[1]

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[1] Vickers and Bird, 1949, pp. 157-160.

[2] Burpee, 1940, p. 406.

[3] Nute, 1943.

[4] Burpee, 1927.

[5] Kenney, J. F., 1929.

On the basis of the three lines of evidence mentioned above, it may be concluded tentatively that the people from the Stott Site were probably Assiniboine.

With the above facts as to time and probable tribe of the Stott Site people at our disposal, it is possible to reconstruct the past life of peoples at the Stott Site with a fair degree of accuracy. Judging from the vast amount of buffalo bone in the refuse at the Stott Site, it would seem that these people were primarily hunters. Also, the great thickness of the layer of bone just below the top of a steep bank leads one to conclude that many of the bison were run into a pound and killed by stampeding them over the bank. The numerous small points in with the bones reveal that, once in the pound, some were shot with bow and arrow. The presence of some other animals in with the bones of the bison "kill" indicates that other animals were hunted or trapped. The pit under the mound and one of the pits in the buffalo bone deposition were filled with fire-cracked rocks, indicating that the meat of animals was usually roasted. Large pieces of carbon adhering to the inside portion of sherds seem to indicate that some food was also boiled or cooked in clay vessels.

Fire-pits in, above, and below the buffalo bones seem to indicate that there were more than just one buffalo "kill" and perhaps more than one occupation of the site. In fact, since the site may be identified as Assiniboine, it seems probable that the site was not continuously occupied but, rather, was a summer or winter camp occupied intermittently by the same group over a considerable length of time. Furthermore, since the camp covers a large area, it could hardly have been just a small group. Perhaps this group, like its descendants the Assiniboine in 1732, was living in some sort of tipi. The large full-grooved mauls may have functioned as mauls for driving tent pegs into the ground.

It can be inferred by a study of the artifacts that the group had at least four important industries. Pottery was manufactured and is present in some abundance throughout the site's refuse. In pottery manufacture, after the clay had been kneaded and the temper put in the clay, a vessel was built by the coil method. After this preliminary vessel was formed but was still wet, it was paddled into shape by striking it with a small paddle wrapped with thongs while one hand held the pot in the interior. Next, the upper neck and rim were smoothed and decorated by impressing the edge of the thong-wrapped paddle into the smooth area. After the pot was dry, it seems to have been fired in the local camp-fire. The lack of oxidation of some of the pottery seems to indicate that no special kiln or draft fire was employed.

If one can judge from the numerous stone scraping tools, the preparation of hides was a very important industry, perhaps more important than the manufacture of pottery. The small flake side scrapers were probably used as knives for separating the skin from the animals. Next, the skin was hung up and the flesh removed from the skin by a bone fleshing tool (such as Mr. Bird found in the refuse). Then, perhaps after some sort of soaking, the skin was scraped by the small end scraper set in bone handles (Plate V, 7-10). Finally, a large ovoid blade (Plate V, 14) was rubbed on the skin to give it a fine finish.

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[1] Lowie, 1909.

Two other industries of some importance were the making of bone tools by cutting and abrasions, and flint knapping. There may have been other important industries, but we have no archæological evidence of them.

The flint used in flint knapping does give us some hint as to trade relations. Much of the flint found in the site is an amber coloured material which came from the Knife River in South Dakota, whereas another type of stone is a quartzite that may have come from the Precambrian Shield in northern or eastern Manitoba. A few chips of obsidian indicate contacts with the Rockies to the west or southwest. The columella shell used in beads comes from the Gulf of Mexico. Whether this trade was of an indirect nature or accomplished by long trading trips is unknown. Means of transportation is equally obscure, but since the dog travois was in use by the Assiniboine in La Vérendrye's time, a half century to a century later than the Stott Site, and since we found remains of dogs, it may be surmised that such was known and used by the people of the Stott Site.

Other than the beads and pendants found in the Stott Site, nothing is known of the personal ornamentation or dress of those people. Art, as such, is represented only by the geometric designs on the pottery, and music by the flute found with the burials.

Social organization and customs are even more obscure in the archæological record, and inferences drawn from those of Assiniboine, after they obtained the horse and the typical "Plains culture", would be misleading. However, the placement of a male in a prominent position in the Stott mound as well as in other Manitoba mounds, and the fact that this burial was the only fully articulated one, would seem to show that the mound was built for him not too long after his death. It also suggests that his status was a high one (perhaps there was some sort of a chief status at the time of the occupancy of the Stott Site). The non-utilitarian fire-place of the burial mound may indicate some sort of death ceremonies.

Furthermore, the objects with the dead suggest some kind of belief in the after life, and the mound-building over the burial, some variety of group co-ordination. The dog associated with the human burials may indicate that the "white dog" ceremony or sacrifice was in existence at the Stott Site.

Future investigation of sites like the Stott Site may give us more information concerning the way of life of these ancient peoples and perhaps eventually a good historical reconstruction of the past of the Assiniboines.

CONCLUSIONS

In this section the historical problems of the mounds in the light of the Stott Site and the other sites related to it are re-examined. The Stott mound seems to have been built in very late prehistoric times, and Henry's description of burials suggests that they were built even in historic times. Thus, in answer to the problem of when the mounds of Manitoba were built, all evidence uncovered so far indicates they were built in late prehistoric and early historic times.

The question of why the mounds were built can be answered only partially at present. Obviously the mound was built for burial, but the question of exactly how the practice of burial mound-building functioned in the ancient society is unknown. It might be guessed that interment in burial mounds is a mark of high social or political status within the society. Of the religious beliefs that motivated the mound-builders we have no knowledge.

The question of where the mound-builders or their culture came from is as yet unanswered. As has been indicated in the comparative section of this paper, the Manitoba mound-builders belong to the Manitoba Focus that is closely related to the Blackduck Focus of northern Minnesota. Thus in late prehistoric times a single culture extended from northern Minnesota westward across southern Manitoba and southwestern Ontario. Much of the development of the culture seems to have occurred in this area, but its ultimate ancestors are still not known.

The question of what happened to the mound-builders and who they were is partially answered. Evidence has been presented that they were prehistoric and early historic Assiniboine. Therefore, what happened to the mound-builders is connected intimately with what happened to the Assiniboine. The fact that mounds were not built by the Assiniboine in the late eighteenth and nineteenth centuries is undoubtedly connected with the Assiniboine's use of the horse, and participation in Plains culture at that time.

In the historic reconstruction an attempt has been made to outline what little is known of the mound-builders' culture. Future work on similar remains should enlarge our knowledge of this matter. In fact, most of these tentative conclusions should be confirmed by further investigation. Also, the hypothesis that the Assiniboine, not the Cree, were the original inhabitants of Manitoba and that their culture evolved in that region, should be put to test.

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PLATE I

1. Vertical profile from W20 to W15 showing the two humi, the original edge of the mound with loading to the right of it and wash to the left.
2. Cross-section of the mound along the S10 profile showing the underlying yellow clay, the old humus, the loading in the mound, and the present top humus.
3. The skull of the dog burial in pit 3 in square W10.

1

2

3

PLATE II

1. Central burial pits before excavation showing the logs over pit 5 in the foreground and the rocks and buffalo skulls over pit 4 in the background.
2. The excavated central burial pits showing burials XV-A-96 and 97 in pit 5 in the foreground, and burial XV-A-101 in the bottom of pit 4 in the upper right-hand corner of the picture.

1

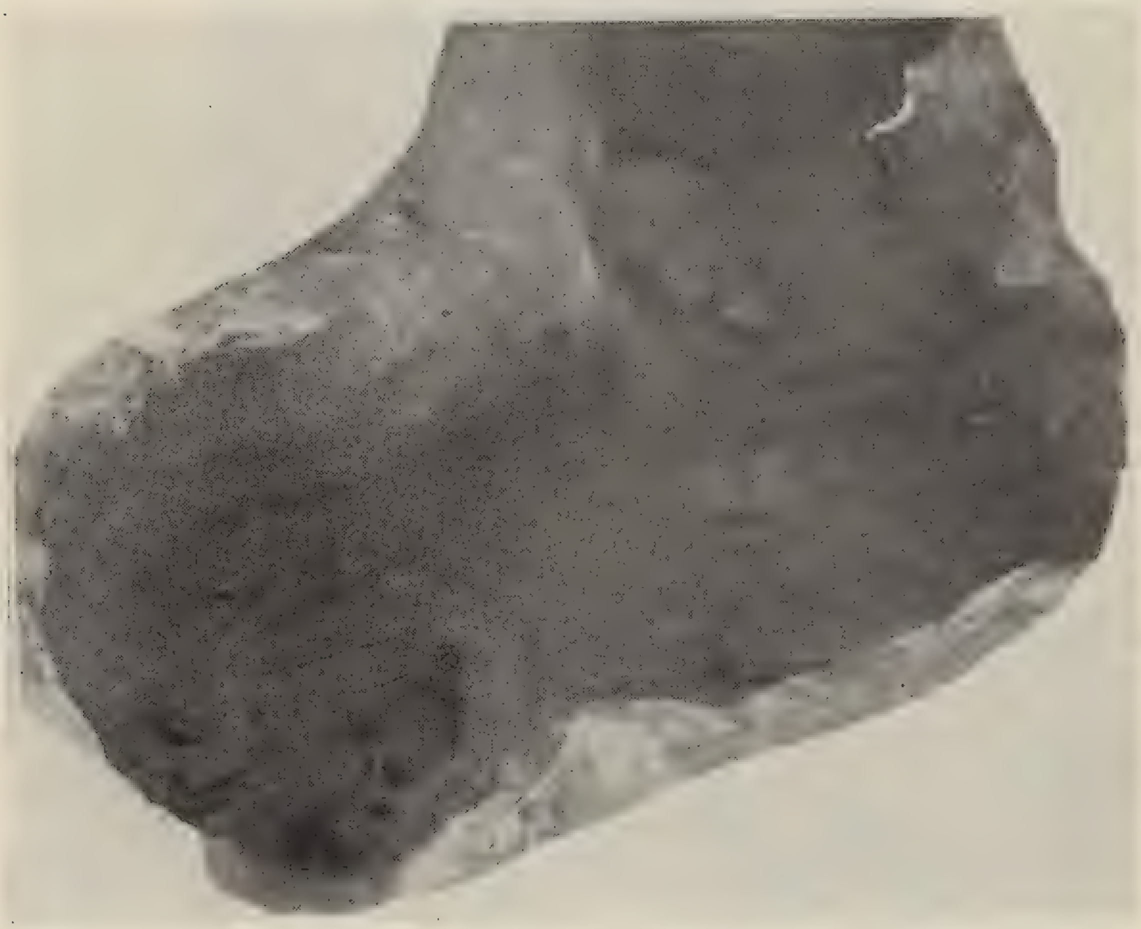

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Plate III

1. Looking southward into pit 5 with burial XV-A-96 on the right, burial XV-A-97 to the left and the separate arms, burial XV-A-100 at the far end of the pit.
2. Looking southward into pit 4 showing burial XV-A-101 under the layer of cedar bark.
3. Looking southward into intrusive pit 6 with burial XV-A-104. Note columella bead in front of partially disturbed skull.

Plate III

1

2

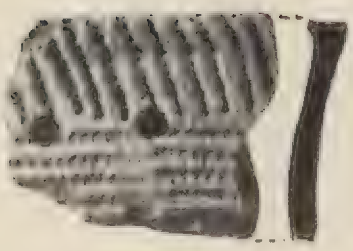
3

Plate IV

(½ natural size)

1. Manitoba Horizontal Pottery Type (Cat. No. 329 in the Bird collection at Brandon, Manitoba).
2. Manitoba Horizontal Pottery Type (Cat. No., Nat. Mus. of Can. X-A-1353a).
3. Manitoba Brushed Pottery Type (Cat. No. 451 in the Bird collection at Brandon, Manitoba).
4. Stott Triangular Pottery Type (Cat. No., Nat. Mus. of Can. X-A-1322).
5. Stott Triangular Pottery Type (Cat. No. 390 in the Bird collection at Brandon, Manitoba).
6. Stott Noded Pottery Type (Cat. No., Nat. Mus. of Can. X-A-1360a).
7. Regina Ware rim sherd (Cat. No. 327 in Bird collection at Brandon, Manitoba).
8. Aberrant smooth necked sherd (Cat. No. 477 in Bird collection at Brandon, Manitoba).
9. Belmont midden sherd (Cat. No. 11 in Bird collection at Brandon, Manitoba).
10. Mandan-like sherd (Cat. No., Nat. Mus. of Can. X-A-1413a).
11. Cambria sherd (Cat. No. 100 in Bird collection at Brandon, Manitoba).
12. Aberrant sherd (Cat. No. 168 in Bird collection at Brandon, Manitoba).

PLATE IV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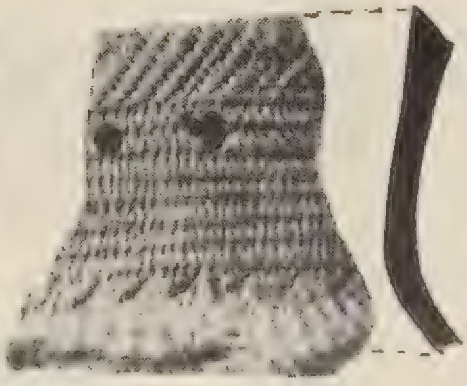
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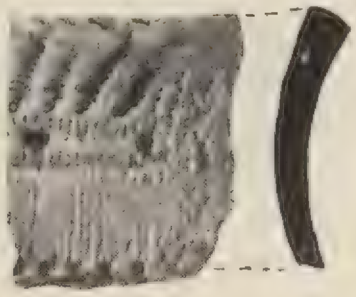
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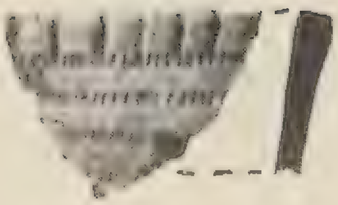
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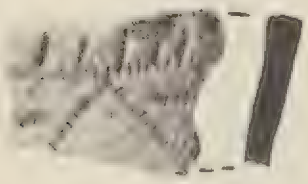
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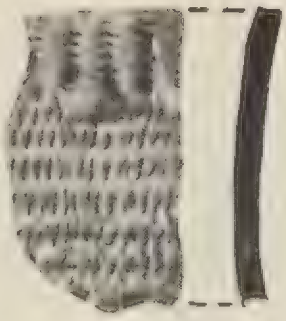
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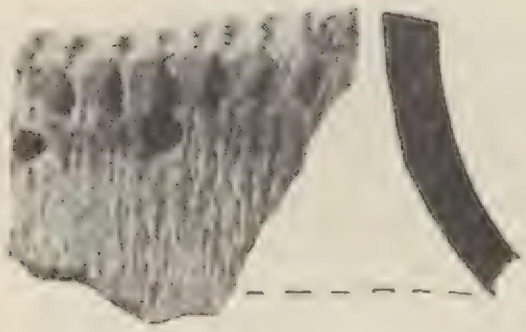
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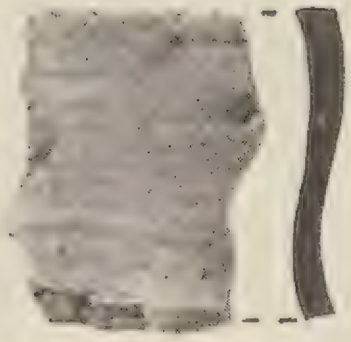
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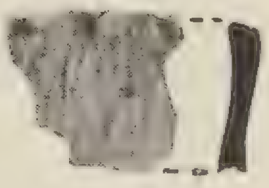
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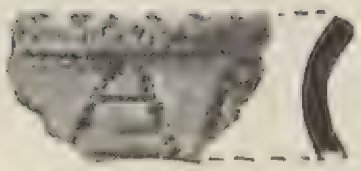
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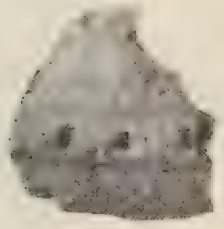
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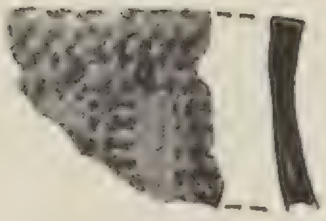
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PLATE V

(½ natural size)

1. Plains Triangular Projectile Point Type (Cat. No., Nat. Mus. of Can. X-A-1397c).
2. Plains Triangular Projectile Point Type (Cat. No., Nat. Mus. of Can. X-A-1405b).
3. Prairie Side-Notched Projectile Point Type (Cat. No., Nat. Mus. of Can. X-A-1422).
4. Plains Side-Notched Projectile Point Type (Cat. No., Nat. Mus. of Can. X-A-1405).
5. Stott Corner-Notched Projectile Point Type (Cat. No. 434 in Bird collection at Brandon, Manitoba).
6. Keeled end scraper (in Bird collection at Brandon, Manitoba).
7. Plano-convex end scraper (Cat. No., Nat. Mus. of Can. X-A-1351a).
8. Plano-convex end scraper (Cat. No., Nat. Mus. of Can. X-A-1309a).
9. Flat end scraper (Cat. No., Nat. Mus. of Can. X-A-1319c).
10. Flat end scraper (Cat. No., Nat. Mus. of Can. X-A-1314d).
11. Ovoid (end) blade (Cat. No., Nat. Mus. of Can. X-A-1374).
12. Semi-lunar side blade (Cat. No. 395 in Bird collection at Brandon, Manitoba).
13. Semi-lunar side blade (Cat. No., Nat. Mus. of Can. X-A-1321a).
14. Hoe-like scraper (Cat. No., Nat. Mus. of Can. X-A-1328a).
15. Full grooved ax (Cat. No. 252 in Bird collection at Brandon, Manitoba).

PLATE V

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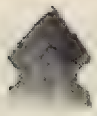
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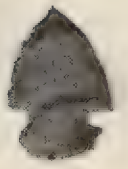
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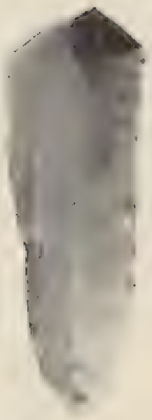
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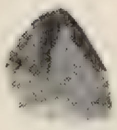
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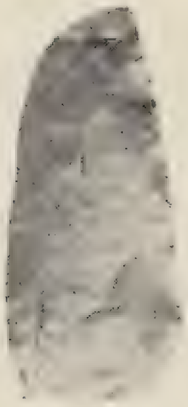
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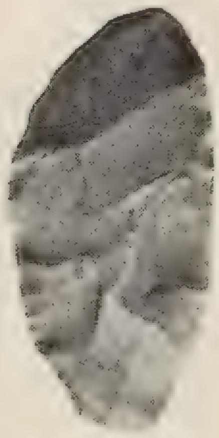
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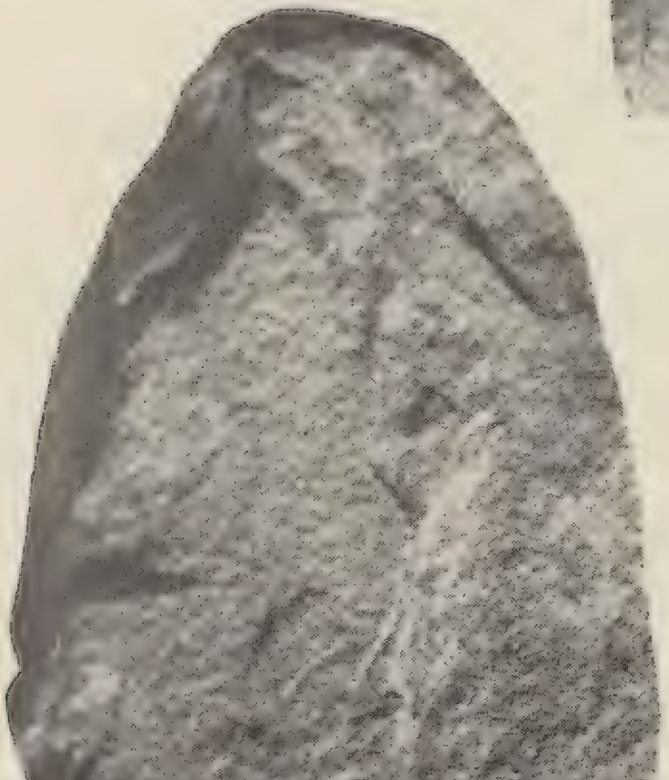
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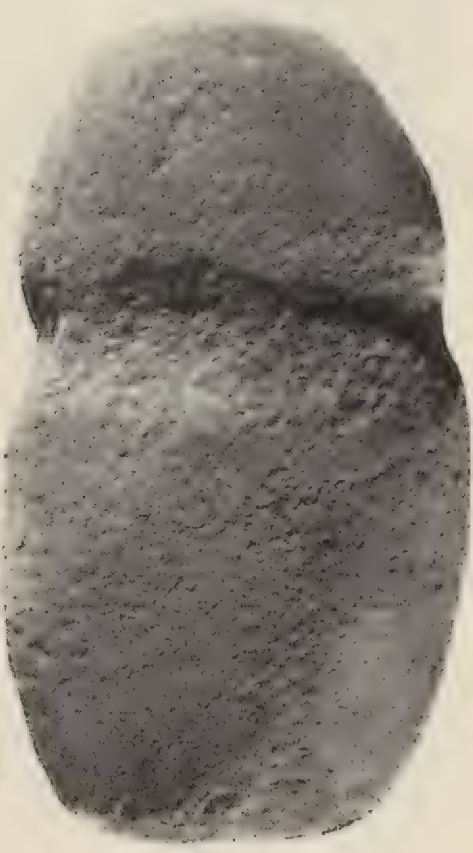
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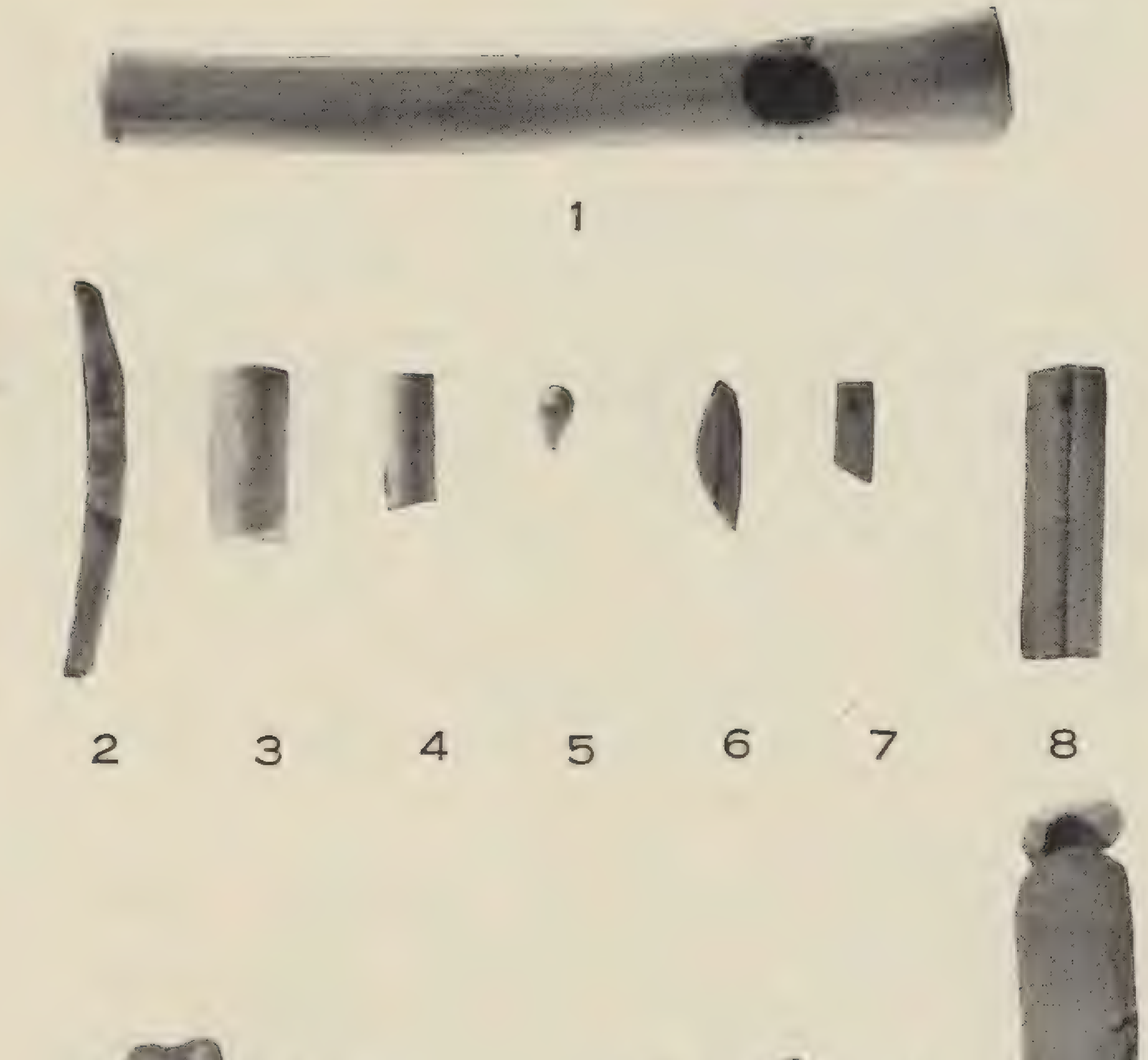
Plate VI

($\frac{1}{2}$ natural size)

1. Bird bone whistle (Cat. No., Nat. Mus. of Can. X-A-1578).
2. Tubular copper bead (in Bird collection at Brandon, Manitoba).
3. Cylindrical columnella bead (Cat. No., Nat. Mus. of Can. X-A-1580).
4. Cylindrical columnella bead (Cat. No., Nat. Mus. of Can. X-A-1579).
5. Oliva shell bead (Cat. No., Nat. Mus. of Can. X-A-1581).
6. Pierced canine pendant (Cat. No. 324 in Bird collection at Brandon, Manitoba).
7. Rectangular bone pendant (Cat. No. 322 in Bird collection at Brandon, Manitoba).
8. Rectangular bone pendant (in Bird collection at Brandon, Manitoba).
9. Bone flesher (Cat. No. 368 in Bird collection at Brandon, Manitoba).
10. Bone hook (in Bird collection at Brandon, Manitoba).
11. Bone awl (Cat. No. 495 in Bird collection at Brandon, Manitoba).
12. Bone awl (Cat. No. 513 in Bird collection at Brandon, Manitoba).
13. Bone flaker (Cat. No. 316 in Bird collection at Brandon, Manitoba).
14. Unilateral bi-barbed bone point (Cat. No. 35 in Bird collection at Brandon, Manitoba).
15. Unilateral uni-barbed bone point (Cat. No. 138 in Bird collection at Brandon, Manitoba).
16. Bone handle with flat end scraper in place (Cat. No., Nat. Mus. of Can. X-A-1431)

PLATE VI



THE GIANT SITE, MANITOULIN ISLAND

By Thomas E. Lee

On the island of Manitoulin, particularly in the Sheguiandah area, are a number of high quartzite ridges. They were observed in the course of an archæological survey in June, 1951, and the question was at once raised whether some early Indian groups might have used material from the ridges in making their necessary tools or weapons. Only twenty miles away on the mainland are the well-known George Lake sites, under excavation by the University of Michigan.[1] Some large quartzite blades have been found on an island near Killarney; a quick check along McGregor Bay on the mainland showed that sites may be expected there also. With these facts in mind, a keen interest was taken in the search for any trace of similar sites on Manitoulin Island. Very quickly the amazing Sheguiandah Site was discovered.[2] Its situation on the top of a hill was quite unexpected; this circumstance led to the investigation of all high places and quartzite ridges, with almost negative results. At last, however, a single crudely-chipped quartzite object was found lying in the midst of a litter of quartzite blocks and fragments on the brow of a quartzite ridge. No further traces were found at the moment, and there was little reason to suppose that a great discovery was only a stone's throw away.

From the brow of the ridge, numerous light-coloured objects were observed in a cultivated field which extended across the lower slopes of the ridge and out upon flat land to the south. These appeared from a distance to be quartzite fragments, but it was supposed, of course, that they were simply the result of normal weathering and slipping from the ridge above. Fortunately, a closer examination was made: although the supposed quartzite objects developed into young cabbage leaves, a few minutes of surface searching made it apparent that a remarkably rich and early site had been found.[3] Lying in the midst of the cabbage plants—carelessly pushed aside by the hoe and cultivator—were dozens of large quartzite blades, ranging up to six inches in width and nine inches in length. There were numerous small quartzite blocks and chips scattered along the base of the slope, often nearly hidden in the heavy clay soil. Closer inspection of these led to the discovery of numerous broken blades. Within a few hours 150 artifacts were found—an early site surpassed only by that at Sheguiandah in Ontario.

Many of the blades are broad, leaf-shaped objects, usually rather thick and crude, about eight inches long and five inches wide. Another frequently-occurring form is a narrow leaf-shaped blade about six inches long. Most of the other forms are variations of the two major types. Only one scraper was found. Among the hammer-stones found were a few that were not quartzite—the only non-quartzite artifacts discovered there.

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[1] Greenman, Emerson F. and George M. Stanley. The Archæology and geology of two early sites near Killarney, Ont. Papers of the Michigan Academy of Science, Arts, and Letters, vol. 28, pp. 505-530, 1943.

[2] Lee, Thomas E. A preliminary report on the Sheguiandah site, Manitoulin Island, 1951.

[3] The name of the site was selected in consideration of the large size of the artifacts, together with the occurrence nearby of a stand of great elms, the trunks of which are well over six feet in diameter, rising out of beds of ferns that are more than six feet high.

The site occupies a narrow belt of land, perhaps 40 feet wide, extending along the base of the slope for about 80 rods. In a few places, cultural traces are found a short distance up the slopes, but the habitation area apparently was on the flat land at the base of the ridge. A short distance to the east, about 200 feet, a small permanent stream emerges from a wooded slope. Between it and the site is a prominent knoll, not quite isolated from the ridge. It is not unlikely that the stream once flowed between the knoll and the ridge, emerging directly at the camp-site when the Indians lived there. Quite possibly it later changed its course, cutting its stream-bed several feet below the present level of the camp.

The cultural relations of the site are probably similar to those of the Sheguiandah Site. On the basis of an inadequate sample from the Giant Site (142 suitable specimens), considerable correspondence is seen in the types of artifacts found on both sites. Different artifact types occur in

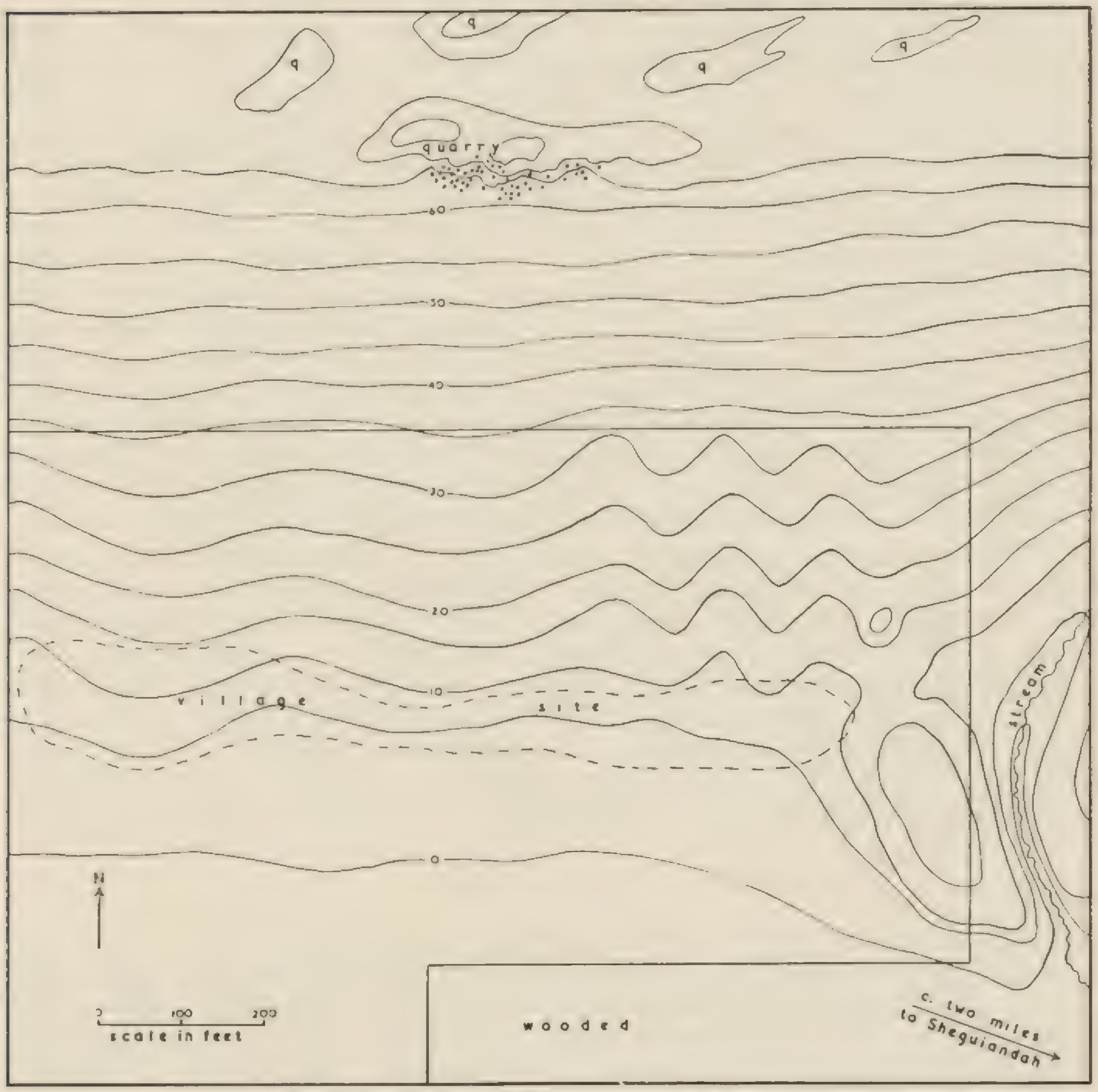


Figure 1. Sketch map of the Giant Site, Manitoulin Island

numbers giving about the same percentages for both sites. The semilunar blade and certain other forms are found on the Giant Site, the Sheguiandah Site, and at George Lake. Some differences are seen, however. The blades from the Giant Site tend to be larger and heavier—less finely worked. The smaller types, suggestive of projectile points, appear to be absent from the Giant Site; this is a matter of some interest, since it might reasonably be expected that they would be found on a rain-washed cultivated surface. Further, although quartzite flakes and blocks are numerous, at no point is there any accumulation of flakes such as is so noticeable almost everywhere on the Sheguiandah Site. Yet the Giant Site yielded nearly one-third as many artifacts in a much smaller area. The period of occupation must have been much shorter here, and the surprisingly high yield of artifacts may be the result of cultivation. The quarry area was again checked, and several crude blades were found. Even at the quarry, however, there are no great concentrations of flakes and blocks. In this respect, little resemblance to the Sheguiandah Site is seen, for no great amount of quarrying appears to have been done here.

What is the age of the site? Unfortunately, the elevation of the flat area was not readily obtainable without instruments, but it is very roughly some 70 feet above the present Lake Huron level. It is probable that the area occupied was along an early shoreline when the lake was higher. Certainly the artifacts and chips occur only near the base of the slope, a position which suggests that the adjacent flat area was either a lake or a swamp at the time of occupation. Until such time as the site can be scientifically excavated, it is necessary to rely principally upon the nature of the artifacts in determining their age. Typologically they are early or pre-ceramic. The apparent absence of projectile points strongly urges this view. The close resemblance to George Lake specimens suggests a cultural connection, however remote in time. That the Giant Site is much younger, however, can be established on the basis of geological dating of lake levels. Unless it can be shown that the artifacts and chips slid down to their present position, the site cannot be older than the time when the waters of Lake Huron stood roughly some 70 feet higher than they do now.

What could be gained by excavation? Certainly a much larger collection would be acquired, probably an adequate sample for comparison with the Sheguiandah Site material. Also, some traces of habitations might still be found below the level of cultivation. It is possible that charcoal concentrations might be found, perhaps suitable for carbon 14 dating. Most important, however, is the possibility that some evidence of an old shoreline might be observed, in which case a few finds of water-worn specimens would serve to associate beach and artifacts; the site could then be dated geologically and have bearing upon the Sheguiandah Site.

SUMMARY

An important early or pre-ceramic site was discovered at the base of a quartzite ridge in 1951, about two miles west of Sheguiandah, Manitoulin Island. Nearly all of the 150 artifacts found were of quartzite, obviously quarried from the ridge immediately above the site. The artifacts are mainly broad or narrow leaf-shaped blades or variations of them. Projectile points are apparently absent. Only one scraper was found. Typologically the site is very early.

Because of its situation at the base of the ridge, this site offers a much better chance than does the nearby Sheguiandah Site for arriving at a maximum date on geological evidence. There is a strong possibility that the camp was along an early shoreline and that some water-worn artifacts might be found below the level of cultivation; these would associate the beach with the site and permit dating. Evidence of some form of shelter might be found below plough depth, since this—unlike the Sheguiandah Site with its mass of quartzite chippings—is an area of deep soil. In such conditions there is some chance of learning about the food habits of the early Indians and gaining a better understanding of the purpose or function of the surprisingly large artifacts. Through this site may come the means of dating the larger and richer Sheguiandah Site.

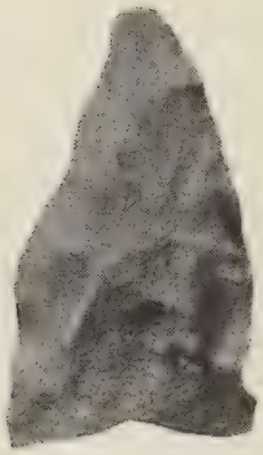
PLATE I

Quartzite Artifacts from the Giant Site
($\frac{1}{3}$ natural size)

Figure 1. Broken blade. From habitation area. Neg. No. J950.
Figure 2. Small blade. From habitation area. Neg. No. J956.
Figure 3. Blade. From habitation area. Neg. No. J952.
Figure 4. Broken blade. From habitation area. Neg. No. J967.
Figure 5. Scraper. Edge retouched. From habitation area. Neg. No. J942.
Figure 6. Blade. From habitation area. Neg. No. J961.
Figure 7. Large unfinished blade. From habitation area. Neg. No. J958.
Figure 8. Blade. From habitation area. Neg. No. J940.
Figure 9. Large unfinished blade. From habitation area. Neg. No. J957.

Photographed by E. C. Elliott.

PLATE I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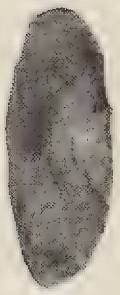
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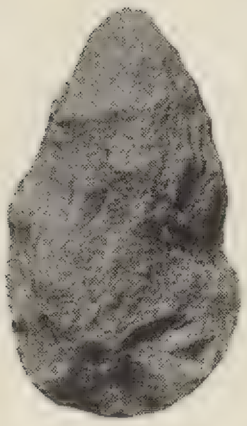
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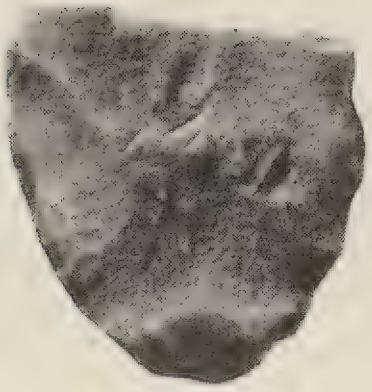
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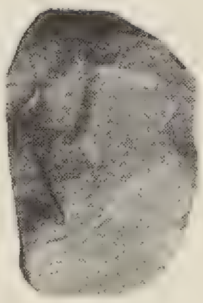
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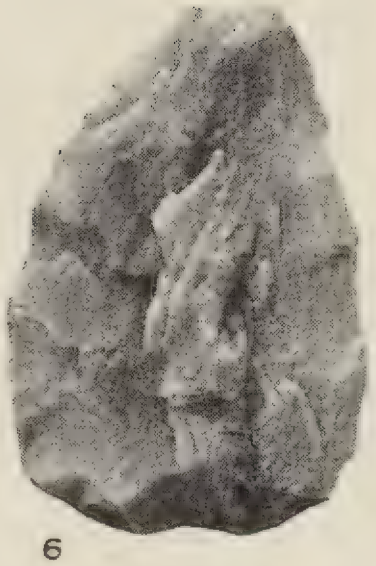
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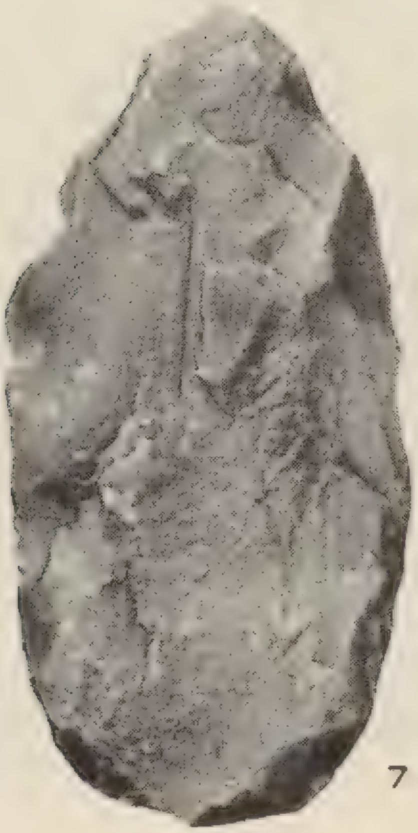
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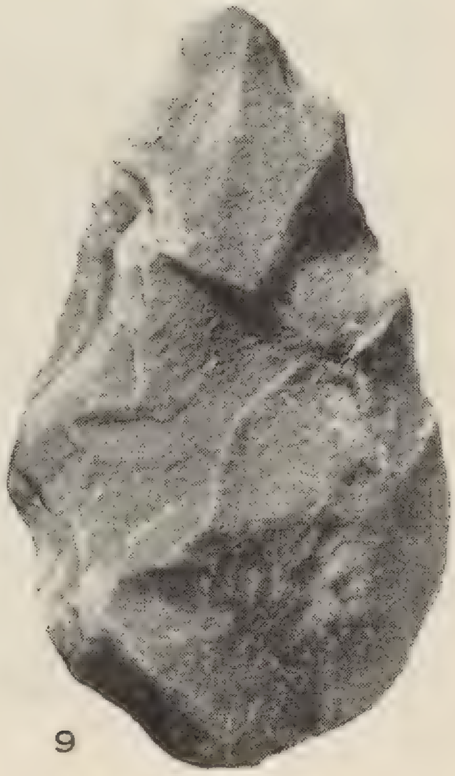
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ANTHROPOLOGY AND FOLKLORE

By Marcel Rioux

Folklore, as an intellectual discipline, is experiencing, at present, some difficulties with regard to its subject matter and its place among the other branches of knowledge which study human behaviour and products of human behaviour. In North America, its long-standing affiliation with anthropology seems to be crumbling. Stith Thompson, one of the most outstanding students of oral literature, reported as follows at a recent international symposium on anthropology: "Recently, we have been hearing reports of a considerable withdrawal of American anthropologists from the American Folklore Society . . . ."[1] Many specialists, on the other hand, have expressed the idea that folklore needs a redefinition, a clarification of its subject matter. However, as Bayard says, "Today when questions of defining the subject or delimiting the field arise, folklorists (and others who wish to comprehend their work) encounter difficulties and experience malaise."[2] Because of a lack of uniformity in terminology and in scientific endeavours in the various countries of the Western World where folklore exists as a study, it is impossible to deal with the difficulties met outside North America when it comes to define the subject matter of folklore. Here, the two disciplines have always been intimately connected, and up to now folklorists have acknowledged that folklore is part of anthropology; on the other hand, anthropologists have been quite unanimous in seeing folklore as an auxiliary discipline to their science. The difficulties between anthropology and folklore lie in the following respect: while cultural anthropologists have restricted the definition of folklore to that of oral literature and music, many folklorists, on the contrary, are not content with that definition and view their subject matter as being much wider; they do not as yet agree on what it should be but feel unduly restricted in the scope of their discipline. In the following remarks, this point will be stressed: If, as North American folklorists and anthropologists claim, folklore should be considered as a part of anthropology, it entails more than simply paying lip service to that connection; it becomes the case of a discipline being subalternated to another one.

As Maritain points out "a science is said to be subalternated to another when it borrows its principles from this other science which is called subalternant . . . the subalternate science does not by itself resolve its conclusions in the first principles of reason, into self-evident principles, but the subalternant science resolves its own conclusions into first principles, and these conclusions of the subalternant science serve as principles for the subalternate science."[3] He adds that when there is subalternation as to the subject matter there is also subalternation as to the principles; the subject of the subalternate science adds a difference which is accidental with respect to the subject of the subalternant science. Maritain gives as an example the science of optics whose subject matter is the *visual line*—*visual* being an accident in regard to the *line* which is the subject matter of geometry. If this reasoning is correct, and I think it is acceptable to any student of methodology, with certain differences in terminology, it follows that for a discipline to acknowledge to be part of another entails some obligations with respect to its subject matter and methodology. It seems that folklore stands in the relationship of a subalternate science with respect to anthropology. The subject matter of anthropology is the study of one determinant of human behaviour, the cultural aspect. Kroeber and Kluckholm define culture as being "patterns, explicit and implicit, of and for behaviour acquired and transmitted by symbols, constituting the distinctive achievement of human groups, including their embodiments in artifacts; the essential core of culture consists of traditional ideas and especially their attached values; culture systems may, on the one hand, be considered as products of action, on the other as conditioning elements of further action."[1] It follows that folklore which, according to anthropologists, studies a portion of culture, oral literature, should be considered as being a science subalternated to anthropology. Being subalternated as to its subject matter, it should also be subalternated to anthropology as to its principles. As optics must not be merely content to study the visual line in order to play fully its role of subalternate science but must study it according to the principles of geometry, so folklore when studying oral literature must take into consideration some of the concepts, theories, and hypotheses of the science of cultural anthropology. It would be perfectly legitimate for folklore to be guided by the canons of erudition, æsthetics, history or any other disciplines; it could not then be regarded as a part of anthropology. As long as folklore claims to remain part of anthropology, students like Hallowell and Bastide will be entitled to advocate that folklorists view their materials from a functional point of view. "Folklore" (oral literature), says Bastide, "can only be understood if its products are viewed in the light of the community [where they are found]. To analytical descriptions . . . which take the facts out of their context, should be substituted a sociological description which alone would replace them within the groups."[2]

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[1] Thompson, Stith. Advance in folklore studies. *In* Anthropology Today, University of Chicago Press, 1953, p. 587.

[2] Bayard, Samuel P. The materials of folklore. J. A. F. No. 259, p. 1, 1953.

[3] Maritain, Jacques. Philosophy of nature, p. 104.

Like any other items of human behaviour or products of human behaviour, oral literature should be viewed from points of view within the range of cultural anthropology. In "Appraisal of Anthropology Today"[3] the following interests are listed: (1) Culture history; (2) Culture process; (3) Comparative sociology; (4) Personality and culture; (5) Substantive fields, comprising (a) technology and economics, (b) social and political organization and law, (c) religion, *folklore*, art, music, science, play, life cycle, (d) language; (6) Areal fields by continents and smaller units. I take it to be that the first four divisions refer to approaches, points of view from which the various substantive fields could be tackled, each point of view having its own concepts and methods. But above these particular concepts which are specific to each approach, there are a few broader methodological principles that are common to all four points of view, such as the concepts of human nature, of culture and of society, and others. In order to study properly the subject matter of folklore, oral literature, here considered as being part of the subject matter of cultural anthropology, one has to take into consideration the general methodology of anthropology plus the specific concepts of one of the four approaches from which the student tackles his problem. The four above-listed points of view could be used in the study of folklore, like in any other substantive field. The first one, although restrained in many ways, has been used extensively in the past: the student merely transcribes, classifies, and sometimes publishes his materials as recorded. One could add as a desideratum that along with the materials recorded, a certain amount of importance be paid to the circumstances under which the materials have been recorded. Information should be given as to the time, the place, the community where and when the phenomena have been recorded; attention should also be paid to the distribution of the item within the community, the amount of interest paid to the informants by other members of the community during the performance; the age, class, and status of participants and listeners. Other data of importance would be the distribution of the phenomena over a certain area, its persistence through the years or its recent adoption. In other words, as many data as possible are requested so as to keep the phenomena in their proper sociocultural context.

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[1] Kroeber and Kluckholn. Culture: a critical review of concepts and definitions. Papers of the Peabody Museum of American Archæology and Ethnology, Harvard University, Vol. XLVII, No. 1, 1952, p. 181.

[2] Bastide, Roger. Le folklore brésilien. Revue de Psychologie des peuples. Déc. 1950, p. 377.

[3] Tax, Eisely, Rouse, Voegelein (eds.). Appraisal of anthropology today. University of Chicago Press. 1953. P. 219.

Another point of view, and most important, would be the study of processes defined as being "any way or mode in which a given state of a system or of part of a system changes into another state. If its study is an object of science, any process is assumed to be subject to laws, which will be stated in terms of determinate interrelations of interdependence between the values of the revelant variables."[1] Questions on how folklore is created and modified would be pertinent here. However, a study of the problems of processes requires an extensive knowledge of the global cultural system to which they pertain; to appreciate fully the interrelations of the factors involved, the specialist should be able to grasp all the meanings and implications of the situation. The folklorist would need here as much training in cultural anthropology as the archæologist and the linguist.

The point of view of comparative sociology could also be tackled by the folklorist, but not in the same way as it was done by Frazer and extreme diffusionists and evolutionists who were inclined to take their materials out of their sociocultural context and compare bare forms together. Not only should the form of the phenomena be compared but also their function, meaning, and use. Again, here, an extensive knowledge of the global system from which the oral literature is taken is desirable.

Finally, folklore could approach its subject matter from the point of view of "personality and culture". Like any other culture trait and complex, oral literature influences in varying degrees the personality of the individuals who are submitted to it. Various authors, among whom Hallowell is prominent, have stressed the importance of that point of view. "Among other things", says Hallowell, "it seems pertinent to ask, for example, whether the study of oral narratives has by any means contributed its full share to our understanding of culture and its functioning in human societies, or whether the study of myth and tale has nothing whatsoever to do with the investigation of human psychology and the adjustment of the individual to his culturally constituted world?" He concludes " . . . more systematic efforts in this direction should be rewarding both with respect to the further documentation and illumination of the relationship between the psychodynamics of individual adjustment and the culture of which the individual is an integral part, as well as the more ultimate psychological problems that concern man as a whole."[1]

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[1] Parsons, Talcott. The social system. P. 201.

Some folklorists have stated their disagreement on the above exposed views; for them the subject matter of folklore is more than oral literature. The argument usually runs as follows: In the past, scholars known as folklorists have been interested in many paths besides oral literature. Students like Frazer, Van Gennep, Nutt, Lang, Krappe, Gomme, and others have shown interest in nearly every trait of human behaviour. The subjects they have studied should belong "de jure" to folklore. Is their claim founded? It is true that at different times most of these students have given descriptions of various phenomena in most alleys of human interests but, unfortunately, no hypothesis—except factual ones concerning origins and diffusion—no concept, no theory has been derived from such descriptions. Bayard, one of the ablest exponents of the divergencies of thought between folklore and anthropology, writes: "the confusion between folklore and anthropology about the specific field of folklore will probably be dispelled in time. No doubt it is partly due to the comparative *lack of a body of theory in folklore*" (Italics mine).[2] On the other hand, many of the folklorists' descriptions have been vitiated by biases which should be foreign to a scientific discipline. A folklorist recently expressed the view that folklore should study the human actions which seem strange, paradoxal, abnormal, curious, picturesque.[3] Bayard realizes that a scientific discipline cannot be founded on such criteria and rejects all the definitions of folklore ever given. However, it is to be doubted whether the procedure which consists in abstracting the subject matter of folklore from the interests of scholars known as folklorists is sound and rewarding. The behaviour sciences have evolved so much in the last fifty years that it seems preposterous to make claims of that nature. A brief look into the history of the two disciplines will show the tendencies which seem prevalent in both. Van Gennep[4] enumerates the various fields which, according to him, have been taken away from folklore: linguistics, technology, statistics, political economy, history, art, literature, legal studies. It seems that with time the various disciplines which have developed have taken as their subject matter phenomena which folklore had first set out to study; it gradually took over odds and ends left over from various sciences. It is not fortuitous if anthropology and common usage have restricted the use of the word folklore to oral literature; it is the gradual accomplishment of a process.

Anthropology, on the other hand, has always been centered around such broad concepts as those of society and culture which, with the years, it has gradually developed. Apart from some sombre years when, in North America at least, anthropology was equated with the cultural history of the American Indians, it has consistently enlarged its subject matter and delved into the theoretical implications brought about through the analysis of phenomena under study. It would be Utopian for folklore to start anew and rediscover the theory of culture. Bayard's last definition of the subject matter of folklore would take a good chunk of the whole subject matter of cultural anthropology: according to him folklore studies oral creative traditional ideas and their products in social life. His creative ideas are "ideas which are not ephemeral or immediately topical, but long-lived; which potently affect the society which adopts them, and show these effects in many social products which are capable of adaptation to differing circumstances and of development as their products themselves develop; and which have had accumulated around them their products in the shape of accretions of belief, action, and emotion."[1] In a sense, this definition of "creative ideas" approximates the definition of culture as given above.

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[1] Hallowell, Irving A. Myth, Culture, and Personality. American Anthropologist, Vol. 49, No. 4, pt. 1, pp. 546-556.

[2] Bayard, Samuel P. The materials of folklore. *In* Journal of American Folklore. No. 259, pp. 1–17.

[3] Marinus, Albert. Mœurs, usages, coutumes, traditions. *In* Nouvelle Revue des traditions populaires. No. 2, mars-avril 1949.

[4] Van Gennep, Arnold. Manuel de Folklore françois contemporain. Paris. 1943.

Those among cultural anthropologists who are interested in folklore and want the association between the two disciplines to be continued cannot do more than repeat what Herskovitz said in his address as President of the American Folklore Society " . . . urging that we explicitly recognize the study of oral literature as our primary concern" and that "folklorists consider customs and beliefs as aspects of what was once our area of interest."[2]

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[1] Ibid. p. 8.

[2] Herskovitz, Melville. Folklore after a hundred years. A problem in redefinition. J. A. F. 59, 232 (1946) p. 100.

ENQUÊTE MENÉE DANS LA BEAUCE, AUPRÈS DE MAÎTRES-BÛCHERONS

par Madeleine Doyon

"J'ai passé dix-sept ans dans les chantiers, dans les chantiers du Canada et du Maine!" Ainsi s'exprimait M. Joseph Maheu, alerte malgré ses 92 ans et encore solide sur ses jambes. Monsieur Maheu est le plus vieux rentier de Beauceville. C'est d'abord vers lui que je dirigeai mes recherches, l'été dernier. Sa mémoire heureuse me dicta force souvenirs sur près d'un quart de siècle de vie forestière. Je consultai ensuite plusieurs autres bûcherons dont deux, M. Noël Doyon (72 ans) et M. Alonzo Doyon (47 ans), me donnèrent, en particulier, une documentation des plus abondantes. Ce sont les témoignages de ces trois hommes, l'ensemble de leurs observations, et non une étude complète de la vie de chantier, qui font l'objet du présent rapport.

La Beauce est une région où l'exploitation forestière connut de nombreuses années de prospérité. La forêt reculant sans cesse devant l'homme, on s'aperçut un beau jour que les chantiers d'importance s'étaient transportés dans le Maine, territoire américain contigu à cette région. Alors, les Beaucerons de traverser la frontière. Aussi, ne nous étonnons pas si le vocabulaire de ces bûcherons est plus que souvent parsemé d'expressions anglaises.

C'est, d'après eux, vers 1900 que le bois a commencé à prendre de la valeur. Ce progrès dépendait sans doute de la grande demande de bois à pâte venant des pays étrangers. Jusque-là la vie du bûcheron, restée dans un état précaire, était mal organisée, et le travail plutôt pénible. Comme on n'avait pas de scie, tout se faisait à la hache: l'abatage des arbres ainsi que les écluses de rivières, en bois rond équarri. C'était aussi bien fini que si l'on s'était servi de la varlope. On choisissait de préférence les hommes les plus habiles à l'équarrissage pour préparer la charpente nécessaire à la fabrication des *dams* (digues) dont les pièces devaient s'ajuster parfaitement les unes aux autres.

On recourait à l'habileté de ces mêmes hommes pour la construction des camps. Autrefois, il y a plus de soixante-dix ans, les compagnies défrayaient les dépenses de construction, mais c'étaient les petits entrepreneurs qui les bâtissaient,—chacun le sien,—et engageaient les hommes. Ils devenaient le contremaître de leur camp. Les compagnies, de leur côté, se réservaient le droit d'avoir leur grand surintendant qui, à son tour, surveillait les contremaîtres.

Les camps étaient tous de forme rectangulaire, construits en bois rond, à un seul étage. Le "camp des hommes" était assez grand pour abriter de quarante à cinquante bûcherons. Le nombre de *beds* (lits) déterminait la grandeur du camp. Le bois du plancher était équarri sur le dessus et calfeutré aux interstices avec de la mousse. Le toit, légèrement incliné, était de bois tendre, fendu en deux dans le sens de la longueur et disposé de façon à ce que le dessus présente une surface plane qu'on recouvrait de terre. La porte d'entrée s'ouvrait, à une extrémité du camp, sur un grand couloir bordé de deux rangées de lits. A l'autre bout, on voyait le quart (baril) contenant l'eau, le seau à boire et l'évier. Dans un coin, la meule à aiguiser les haches. Le poêle, appelé truie, juste au milieu du camp. Et, au-dessus, accrochées au plafond, des croix de broche ou de bois sur lesquelles séchaient, la nuit, les vêtements.

Les lits étaient disposés de chaque côté du camp, en rangées à double étage, pouvant contenir chacun deux dormeurs; la deuxième rangée, à trois pieds au-dessus de l'autre. A deux pieds du sol, on fixait horizontalement des "barattins" (troncs de jeunes épinettes) qui faisaient la "foncière" du lit. On étendait par-dessus, en guise de matelas, une couche de deux à trois pouces de rameaux d'épinette ou de sapin. Plus tard, pour obtenir une couche plus moelleuse, on pensa à piquer verticalement, dans le matelas improvisé, quantité de rameaux qui s'écrasaient assez vite sous le poids des corps, mais qu'on remontait chaque dimanche. On imagina encore une espèce de sommier fait de petites lattes de sapin, clouées à une extrémité, sur une bûche placée à la tête du lit, l'autre bout restant libre. On recouvrait ensuite ce sommier de rameaux ou de foin. On avait alors l'impression d'être couché sur une paillasse reposant sur des ressorts. Chaque homme recevait un *spread* (confortable) de la compagnie. Les lits étant doubles, on pouvait donc étendre un confortable sous soi et se couvrir de l'autre.

Un campement ordinaire comprenait, en outre du camp des hommes, 1° la *cookery* (cuisine) aussi grande que le camp. De longues tables pouvaient loger, de côté, dix hommes assis sur des bancs de planches ou de sapins équarris. A peu près la moitié de la pièce était réservée au *cook* (cuisinier), constituant la cuisine proprement dite et la chambre à coucher. 2° Entre ces deux camps prenait place la réserve des "boîtes à manger", appelée *ding* ou *back-store*. Et enfin, 3° la "jâvelle" (l'étable), tout aussi grande que les camps précédents, dont les pavés, les ports et les crèches étaient en bois rond. Elle se terminait, en arrière, par une rallonge contenant les provisions de foin et d'avoine.

Dans le Maine, les compagnies construisaient en plus, un "dépôt-camp" où elles centralisaient la boutique à ferrer les chevaux, les bureaux des chefs de l'entreprise: la "grande et la petite office", et le magasin général. C'est là que venaient, chaque dimanche, se ravitailler les camps éloignés chacun dans un rayon d'à peu près neuf milles. Le transport des victuailles se faisait toujours à dos d'homme. On "portageait" ainsi de la farine, du gros lard salé, du lard "boucané", du poisson salé, des fèves pour les "beans" et de la mélasse. On servait aux bûcherons de la galette, le matin, réservant le pain pour les autres repas, des "patates à épelures", du thé et des "grillades" de lard salé qu'on appelait des oreilles de crisse. Ce fut, pendant des années, la seule nourriture possible en forêt. Jamais de patates parce que c'était lourd à transporter et trop "geleux", exposées comme elles l'étaient au froid par une si longue distance. Depuis une trentaine d'années, une fois les routes ouvertes jusqu'au cœur de la forêt, on vit apparaître sur les tables des viandes fraîches de toutes catégories, des confitures et des pommes de terre, c'est-à-dire des plats comme on pouvait en manger chez soi, dans sa famille. Pour empêcher le pain et la viande de sécher ou de moisir, au moment du dégel, on les enfermait dans un petit coffre de bois qu'on enterrait dans la neige. Mais, quand les chaleurs commençaient, on pendait les quartiers de bœuf ou de lard à une branche d'arbre, bien exposés au grand air. L'air vif brûlait les chairs. On n'avait qu'à aller tous les jours se couper les tranches dont on avait besoin, et la plaie se refermait aussitôt. Il paraît qu'avec ce procédé, on n'a jamais perdu de viande.

Les camps appartenant tous à la même compagnie, à la fermeture des chantiers, on y laissait la farine qu'on n'avait pu consommer durant l'hiver afin qu'elle puisse servir aux "draveurs", ce qui diminuait d'autant le transport des vivres. La "drave" finie, la compagnie engageait des gardiens pour prendre soin des camps durant l'été,—ils servaient aussi de gardes-feu,—jusqu'au prochain chantier. On peut imaginer facilement combien fertile devenait l'imagination de ces hommes vivant seuls en pleine forêt que la peur ou l'ennui peuplait de fantômes et d'animaux monstrueux. Ainsi naissaient les légendes de chantiers.

Que les hommes fussent à salaire ou à forfait, le travail en forêt a toujours été un travail de compétition. Pas de camp qui n'ait eu son *bully* (fier-à-bras) s'imposant à tous par la vigueur et la résistance de ses muscles. C'est une tradition que, dès l'ouverture des chantiers, on cherche à savoir qui seront les meilleurs hommes de la saison. Chaque dimanche, on affiche à la porte du camp les noms des individus ou des groupes qui ont exécuté le plus de travail, à l'heure. Et c'est un honneur très recherché que celui d'être reconnu le champion, dont le choix ne repose pas seulement sur la grosseur des biceps, mais aussi sur la résistance, l'adresse et l'habileté. Au meilleur homme du camp revenait la charge de "teneu de sleigh". "Virer la sleigh", c'était, disait-on, un "érale-chrétien" (tâche dure et éreintante). Cette sleigh s'appelait le bagon. Faite de bois dur, à deux membres ferrés, elle était très lourde. Il fallait une main rapide et sûre pour tourner le bagon bout pour bout, en un rien de temps, dans un espace restreint.

Ce n'était pas seulement au travail qu'on reconnaissait les bons hommes, mais aussi aux jeux du samedi soir, alors que le règlement du camp permettait, ce jour-là, de veiller jusqu'à minuit. On avait le droit de tout faire tant que la lampe était haute. Les autres soirs, le couvre-feu avait lieu à neuf heures. Le cuisinier venait baisser très bas le feu de la lampe à huile et, à partir de ce moment-là, plus un homme ne devait faire de bruit. Mais le samedi soir, pour oublier les fatigues de la semaine, on se divertissait en chantant ou en écoutant des contes. Le bûcheron qui avait apporté son violon ou sa "musique à bouche" (harmonica), lançait un air de danse, et . . . tout le monde au milieu de la place! S'il s'agissait de grand'danses, ceux qui représentaient les danseuses s'enroulaient un mouchoir blanc ou jaune autour du bras gauche. La gigue était le plus en honneur. C'est à qui aurait inventé les pas les plus beaux, les plus compliqués. Le gigueur, qui suscitait le plus d'admiration par la création de ses pas et par son endurance à la danse, recevait aussi le titre de champion. Mais c'était surtout dans les jeux, jeux de force toujours cruels, qu'on pouvait montrer sa valeur. Seuls des hommes à muscles d'acier et à forte capacité respiratoire résistaient au jeu de l'*Abattage du hibou*, par exemple, ou à la course de la *Bibite à deux têtes*.[1] Les hommes forts, ou se croyant tels, s'essayaient tour à tour à tirer de la jambette ou du poignet. Mais autant on admirait le fier-à-bras, autant on méprisait le faible, celui qui se retirait du jeu ou s'esquivait pour éviter l'épreuve. Il devenait la risée du camp. On était impitoyable aussi envers les jeunes garçons qui venaient aux chantiers pour la première fois. S'ils paraissaient quelque peu timides, on leur faisait subir une sorte d'initiation, d'apprentissage à leur vie d'adulte qui commençait. C'était naturellement l'un de ceux-là qu'on choisissait comme cible dans les jeux d'attrape tels que *Voir la lune*, *Trompe compagnon*, *le Roi de Perse*,[1] etc., d'où la pauvre victime sortait à moitié éreintée, et se retenant de pleurer, de crainte que ne se doublent les sarcasmes de ses compagnons de travail.

Le dimanche était jour de chômage et, par conséquent, tout désigné pour raccommoder son linge, ramasser les "bourrelets" de gomme d'épinette et, quand c'était tôt l'automne, faire des provisions de noisettes et de faînes. On allait aussi défaire les cachettes de castors, visiter les camps voisins et y jouer des tours, chasser l'ours, la perdrix et le lièvre. Plus on prenait de lièvres, plus on recevait de faveurs du "jobbeur". Souvent il n'était pas nécessaire de s'éloigner pour chasser l'ours. Ce dernier venait, la nuit, au *ding* voler les réserves de nourriture du camp. Pour le prendre, on piquait de grands clous dans la gueule d'un quart vide de farine, au fond duquel on mettait un morceau de lard. On rentrait les clous, les pointes légèrement tournées vers le fond, en laissant juste l'espace qu'il fallait pour passer une tête . . . d'ours. Quand l'animal avait fini de manger, il essayait de se retirer la tête qui restait prise entre les clous. Plus il se débattait, plus les clous lui rentraient dans le cou. Ses cris avertissaient les hommes qui, au lieu d'accourir, laissaient l'animal se débattre et se fatiguer jusqu'à l'épuisement. Alors seulement, on le tuait à coups de haches car aucun bûcheron n'avait de fusil au camp.

Il y avait aussi les orignaux, dont il fallait se méfier à l'automne, au moment de la "courre" (du rut des femelles). C'était bien dangereux de s'aventurer seul dans la forêt à cette époque de l'année, car ces bêtes sentent l'homme d'assez loin, et en sont jalouses. Il est arrivé à maints bûcherons, surpris par les orignaux, de se glisser en toute hâte au faîte des bouleaux et d'y rester durant des heures, pendant que l'animal attendait au pied de l'arbre qu'il secouait assez violemment parfois de son panache. A la longue, il devenait furieux, et on l'entendait avec crainte se faire "péter les ballots" (vibrer les babines).

C'était aussi le dimanche qu'on s'exerçait à faire le plus beau manche de hache ou de "*kankdog*", qu'on fabriquait de menus objets de bois "gossé" au couteau ou sculptés, comme des boîtes à cigarettes, des boîtes à bijoux pour sa belle, etc. La plupart des jouets de bois ont pris naissance dans les chantiers, tels la "sauterelle" et le "tric-trac"[2]. La sauterelle n'est autre qu'une planchette rectangulaire, étroite et mince, attachée à une longue corde qu'on fait tournoyer dans l'air. La "sauterelle" bruit comme une libellule,—d'où son nom,—ou vrombit comme un moteur d'avion selon le degré d'impulsion qu'on lui donne.

Le printemps arrivé, on profitait encore des heures libres du dimanche pour fabriquer les traits à haler, en utilisant l'enveloppe intérieure de l'écorce de bois blanc. L'écorce était tendre et se "pleumait" bien au moment de la sève. On en arrachait aisément de grandes lanières dans toute la longueur de l'arbre. On les taillait avec un couteau, comme pour la "babiche" (cordon de cuir), à peu près un demi-pouce de largeur. C'était fort comme des nerfs.

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[1] Ces jeux sont décrits aux numéros 164, 165, 190, 193, 194 de "Jeux, jouets et divertissements de la Beauce", *Archives de Folklore*, 1948, III, pages 159-208.

[2] Description de ce jouet, *Archives de Folklore*, 1948, III, nº 92, p. 184.

On fabriquait aussi ses canots pour la drave. Les premiers dont on s'est servi étaient construits d'après le modèle des canots sauvages, non en écorce, mais faits d'un tronc de pin creusé comme une auge. Pour empêcher que le bois ne se fende, on coupait le pin en décembre, au moment où la sève ne monte plus; la résine se formait alors dans les fibres du bois et le conservait à la façon d'un vernis. On faisait le canot bien creusé, dans un tronc de vingt pieds de longueur auquel on laissait un pouce d'épaisseur. Ce travail s'accomplissait lentement. Cependant, il valait la peine de l'entreprendre vu qu'un canot pareil durait toute une vie. On "pleumait" le tronc et on le cirait avec de la gomme de pin pour qu'il ne "pétasse" (craqueler) pas. On le taillait dans les deux bouts, ce qui l'empêchait de verser. Et comme le pin sec n'était pas pesant, en deux coups de "gaffes", on traversait les rivières. On construisait aussi pour la drave, des cajeux appelés chiennes. C'étaient trois à quatre pièces de bois liées ensemble et pouvant porter un homme ou deux. Ils se manœuvraient avec une *pole* ou avec une gaffe, mais on les utilisait seulement en eau stagnante. Dans les conversations naissaient aussi toutes sortes d'inventions. On avait imaginé, pour aider au charroyage du bois dans les montagnes, deux espèces de freins: la "bradelle" qui consiste en une chaîne passant tordue en dessous d'un membre ferré de la sleigh; et le "veau" qui est tout simplement une demi-corde de bois chaînée traînant derrière une charge. Rendu au bas de la côte, le charroyeur détache le veau et le porte par-dessus sa charge, ce qui lui fait double cargaison. Dans une côte bien à pic, il est préférable de faire traîner deux veaux plutôt qu'un gros. Le frein est ainsi plus souple et plus fort.

Pour accomplir ces travaux variés, il fallait des costumes appropriés. Ainsi le bûcheron qui dépense beaucoup d'énergie n'a pas besoin d'être aussi chaudement vêtu pendant qu'il travaille, que le charroyeur, et son vêtement doit le protéger autrement que celui du draveur. La mode étend ses faveurs à la forêt comme à la ville. Là comme ailleurs les costumes ont bien changé durant les sept dernières décennies. Autrefois, le bûcheron portait la tuque de couleur (bonnet de laine à pompon), chemise et sous-vêtements de flanelle, culotte et blouse d'étoffe foulée, gilet sans manches, en cuir ou en étoffe, bretelles et mitaines de cuir cousues à la babiche, trois à quatre paires de bas retenus par des jarretières fléchées ou tressées, bottes malouines avec semelles et talons fixés à la broquette de bois. Le charroyeur, moins actif, devait se couvrir davantage pour se protéger contre le froid. Aussi revêtait-il le gros capot d'étoffe grise descendant aux genoux ou bien le capot de cuir, une grosse calotte carrée avec oreilles et bordure en fourrure, et "crémone" de laine tricotée, autour du cou. S'il avait trop chaud, il se l'enroulait autour du corps. Il portait double paire de mitaines, l'une de cuir, l'autre de laine, cinq à six paires de chaussettes, et, dans les gros froids, il enfilait par-dessus ses bottes, des chaussons de grosse étoffe à semelles piquées. Quant au draveur, comme son travail n'avait lieu qu'au printemps, sous un soleil déjà chaud, il se couvrait plus légèrement que le bûcheron, mais ses habits étaient quand même exclusivement de cuir et de laine.

Il y a une quarantaine d'années environ, la botte malouine fut remplacée par le mocassin à bas quartier, en peau verte d'orignal, qui se laçait et montait à peine au-dessus de la cheville. Ce mocassin ou "moussaye" n'a, paraît-il, jamais été fabriqué au Canada, mais aux États-Unis. Ceux que les sauvages du Lac-Saint-Jean vendaient n'étaient pas du même modèle. Les deux pans de la jambière plus large ne se laçaient pas, mais se croisant sur la jambe étroitement, ils étaient retenus par des lanières de cuir. Le "moussaye" développa l'usage des *leggings*, ou bas très épais, s'arrêtant aux genoux, et attachés d'un cordon rouge à glands de la même laine que le bas. Ces bas étaient carreautés ou fléchés. Les femmes, en les tricotant, entremêlaient des couleurs vives et contrastantes. Au fur et à mesure que les salaires devinrent plus élevés, les bûcherons délaissèrent les habits confectionnés à la maison pour n'endosser plus que des vêtements manufacturés.

Aujourd'hui, les camions ont envahi la forêt; les appareils de radio se sont installés dans les camps devenus autant d'hôtels offrant le confort de la vie moderne. L'esprit de corps se dissocie. La vie forestière se commercialise et s'adapte progressivement aux tendances actuelles de la vie urbaine.

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A NEW SPECIES OF EURYPTERID FROM THE DEVONIAN OF GASPÉ

By Loris S. Russell

INTRODUCTION

The occurrence of eurypterids and ostracoderms in the Gaspé Sandstone series at D'Aiguillon, on the northwest side of Gaspé Bay, Quebec, was reported previously by the writer (Russell, 1947). Specimens were obtained by a joint expedition of the Royal Ontario Museum and the Department of Geology of Laval University. In 1950 C. M. Sternberg collected at this locality on behalf of the National Museum of Canada, and his invertebrate specimens have been deposited in the Palæontological Collection of the Geological Survey of Canada. The present paper is a description of the eurypterid remains. An account of the ostracoderms is in preparation.

SYSTEMATIC DESCRIPTION

Pterygotus gaspesiensis, new species

Definition. Size rather large for the genus, reaching a length exclusive of appendages of about 650 mm. Metastoma narrow, broadly notched in front, subangulate behind. Supposed telson subquadrate, with posterior projection at posterolateral angle.

Type. No. 26805, Division of Invertebrate Palæontology, Royal Ontario Museum of Zoology and Palæontology, Toronto.

Occurrence. Gaspé Sandstone series (Battery Point formation), about 2,300 feet above base of series; presumably Middle Devonian. Sea cliff 1,360 feet east of D'Aiguillon wharf, County of Gaspé South, Quebec.

Description. The holotype (Plate I, figs. 1, 2) consists of a large part of the dorsal integument, including the carapace and part of the abdomen as far back as the 10th tergite. The ventral surface is represented by a portion of the cephalic doublure and by the metastoma. The specimen consists of natural mould and cast, the latter being restricted to the doublure, a large part of the carapace, and parts of four tergites. This was the first recognized specimen of a eurypterid to be found at the locality and was discovered by René Bureau of the Department of Geology, Laval University.

The carapace is broadly semi-oval, rather than subquadrate, in outline, being broadly convex on the sides, more narrowly rounded in front, and truncated along a gently sinuous line posteriorly. The surface is marked by numerous winding and branching grooves (ridges on the mould) which are 2 to 3 mm. in width and show no symmetrical pattern. There is also considerable wrinkling, probably formed during fossilization. Along the anterior margin some fine striation is visible. The lateral eyes are represented by oval prominences, longer anteroposteriorly than transversely. They are situated near but not at the margin in the anterolateral region. The oval prominence for the ocelli is located in the midline a little behind midlength. It shows some trace of concentric markings.

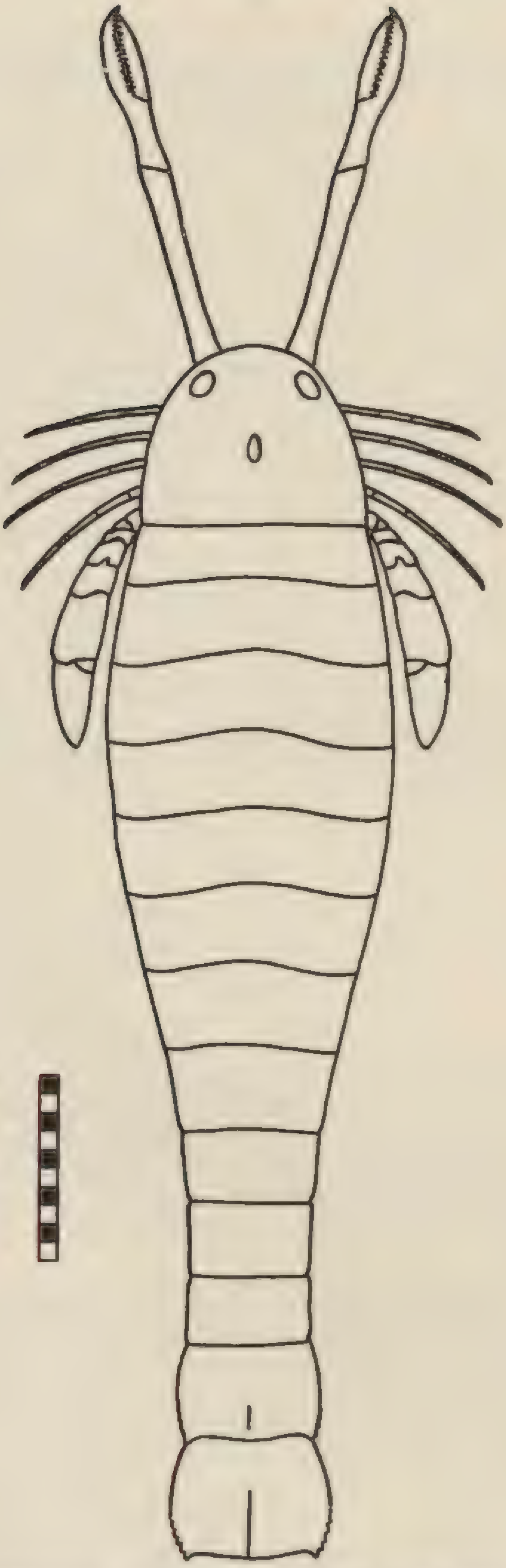

Figure 1. *Pterygotus gaspesiensis,* outline restoration of dorsal aspect; appendages except chelae based on other species. Scale in centimetres.

Adjacent to the anterior and right lateral margins of the carapace is a crescentic structure which is interpreted as the doublure unfolded from beneath. It is widest immediately in front of the carapace and tapers gradually to a slender tip in the vicinity of the posterolateral angle. The surface bears coarse, angulate "scales" and some sharp wrinkling.

The tergites, as preserved, have the anteroposterior width nearly constant from one side to the other. The outline is gently sigmoid, being broadly convex forward in the vicinity of the midline and becoming concave forward towards the lateral margins. The squamation is well marked on the surface of each tergite for about the anterior third but becomes obscure farther back. The "scales" are small, are much wider than long near the anterior margin of the tergite, but rapidly increase in length, with a slight decrease in width posteriorly, until they are elongate-triangular in shape. There is some overlap of each tergite on the subsequent one. The lateral margins, as preserved, show a continuous outline, without re-entrants at the termination of segment boundaries. The outline indicates that width of the abdomen increased posteriorly to the vicinity of the third and fourth tergites, and decreased from there.

The metastoma (Plate I, figure 3), although broken, is almost complete. It has a graceful shape, somewhat more slender than is usual in this genus. The anterior border has a broad excavation, giving it a shouldered appearance. The width increases for about the anterior quarter of the length, then tapers in a gently curved outline to the subangular posterior. The surface shows distinct squamation, consisting of broad "scales" on the anterior part and narrower "scales" on the posterior; in the median section the squamation is obscure. The metastoma lies to the left of the mould (original right side) and has been inverted so that it faces in the opposite direction to that of the carapace and abdomen.

MEASUREMENTS

	mm.
Length of carapace at midline	109
Width of carapace between posterolateral angles	119
Length of 4th tergite at midline	43
Width of 4th tergite, as preserved	155
Maximum length of metastoma, as preserved	94
Maximum width of metastoma, as preserved	44·5

Specimen No. 26806, R.O.M.Z.P. This is a natural mould showing parts of nine tergites, the most anterior one probably being the original 3rd. The anterior and posterior margins of the tergites are nearly straight, in contrast to the sigmoid curve seen on the holotype. The best-preserved tergite, probably the original 4th, is 162 mm. in width, as preserved.

Lying adjacent to the left (originally right) side of the tergites is the distal part of a chelicera, showing the chelae (Plate II, figure 1). The outline of the chelae is gently curved, with rounded tip. Both rami are denticulate, the teeth being of various sizes and vertically striate. Other features of the chelae are obscure.

Specimen in Museum of Geology, Laval University. A small individual, represented by the natural moulds of nine tergites. The squamation is obscure but is evidently much finer than that of the two previously-described specimens. The tergites narrow rapidly behind the fourth, and the ninth and tenth are distinctly longer than wide. There are remnants of the ventral surface preserved anteriorly, and an impression of the median opercular lobe is visible through the second and third tergites. This lobe is elongate, expanded in front, and has median and two lateral ridges. Width of the fourth tergite is 105 mm.

Specimen No. 10326, Geological Survey of Canada (Plate II, figure 3). Natural mould showing parts of five posterior segments, the last of which is interpreted as the telson. This is a large plate, almost rectangular in outline, and wider than long. The posterior margin is gently convex, with a posterior projection at the posterolateral angles. The lateral margins are distinctly convex and are serrate along their posterior half, the serrations being formed by marginal "scales". Elsewhere on the surface, squamation is confined to the anterior third or less, extending a little farther back along the midline than laterally. There is a distinct median keel along the posterior two-thirds of the surface, but there is no median projection at the posterior margin. The form of the posterior margin, as well as the broad outline of the segment, suggests the possibility that this is the last tergite, rather than the telson. This view is not adopted here for the following reasons: presence of the prominent median keel; restriction of the squamation; absence of any trace of a more posterior segment. The segment in front, here interpreted as the last tergite, is as broad as the supposed telson but is only about two-thirds as long. It has a distinctly convex lateral margin and a posterior projection at the posterolateral angle. Other characteristics that support its identification as the last tergite are the small but distinct median keel in the posterior half, the restriction of squamation to the anterior half of surface, and the serrate posterior half of the lateral margin. Maximum width of the supposed telson is 96 mm.; maximum length, 74 mm.

Specimen in Geology Museum, Laval University. Part of the carapace of a small individual, preserved as a natural mould. The surface has the same wrinkled appearance as in the holotype. It is interpreted as distorted, so that the right eye (left side of mould) is now marginal, whereas the left eye is near the centre of the impression. The width of the carapace near the posterior margin is 74 mm.

DISCUSSION

Fragmentary remains of *Pterygotus* have been reported from the Lower or Middle Devonian of the Gaspé region by Logan (1863, p. 399, fig. 428), Whiteaves (1883, p. 100), and Clarke (1908, p. 243). The material mentioned by Whiteaves was subsequently described by Clarke and Ruedmann (1912, p. 356) under the name of *Pterygotus atlanticus*, new species. The types are in the collection of the Geological Survey of Canada and have been examined and photographed by the writer. In the notice of the discovery of the D'Aiguillon locality (Russell, 1947, p. 3), it was suggested that the eurypterid material might prove referable to *P. atlanticus*. It now appears that this is very improbable. The fragment described by Clarke and Ruedmann as a part of the metastoma (Plate I, figure 4) indicates that this structure is broadly ovoid and very unlike the narrowly elongate metastoma of *P. gaspesiensis.* The ramus of the chelae (Plate II, figure 2) is relatively slender and has the outer margin nearly straight, instead of broadly convex as in *P. gaspesiensis.*

Pterygotus remains have long been known from the Upper Silurian of New York State. Clarke and Ruedmann (1912, p. 349) recognized eight species. Some of these are not strictly comparable with the present species, but the following notes will serve to distinguish most of them. *P. macrophthalmus* has an ovoid telson, longer than wide, and a moderately elongated metastoma, with rounded posterior. *P. buffaloensis* has an ovoid, almost circular, telson and a metastoma not excessively elongate, sometimes truncate posteriorly. In both of these species the carapace is less rounded than in *P. gaspesiensis. P. globiceps* has a subcircular carapace. *P. grandis* has a telson that is transversely elliptical, with scalloped posterior margin. *P. monroensis* has very large eyes, which are angulate on the inner side. *P. nasutus* has a carapace with a five-sided outline. *P. prolificus* has relatively large eyes.

The two best-known British species of *Pterygotus* are *P. anglicus* Agassiz from the Lower Old Red Sandstone of Forfarshire and *P. bilobus* (Salter) from the Ludlovian of Lanarkshire (Woodward, 1866–78). *P. anglicus* has an ovoid telson, longer than wide, with a distinct terminal projection. The metastoma is relatively broad, with a rounded posterior. In *P. bilobus* the telson is also ovoid and longer than wide but has a terminal indentation to the outline, giving the bilobate appearance that suggested the name. The metastoma in this species is narrower than in *P. anglicus* but is rounded posteriorly.

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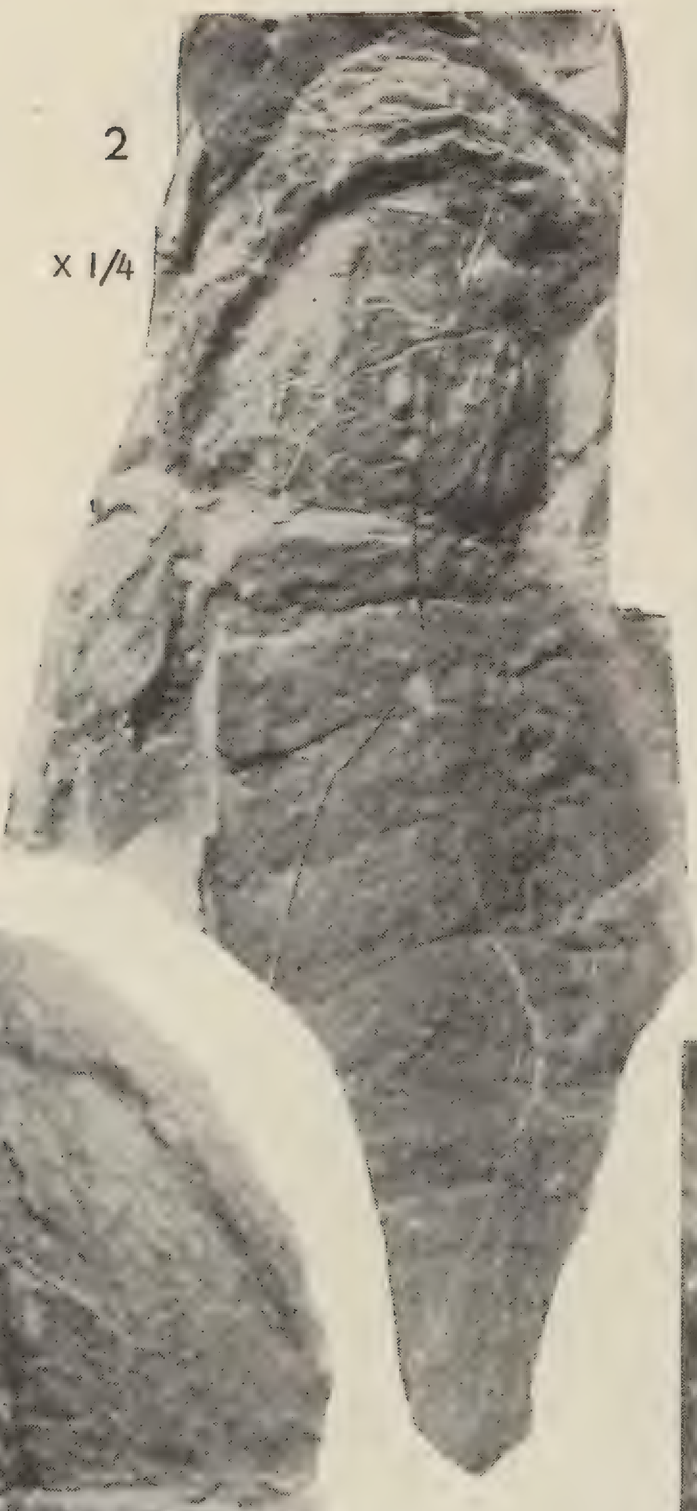
Plate I

Figure 1. *Pterygotus gaspesiensis*, holotype (R.O.M.Z.P. 26805), incomplete carapace and abdomen, positive. X $\frac{1}{3}$.

Figure 2. *P. gaspesiensis*, holotype (R.O.M.Z.P. 26805), carapace, incomplete abdomen, and metastoma, negative. X $\frac{1}{4}$.

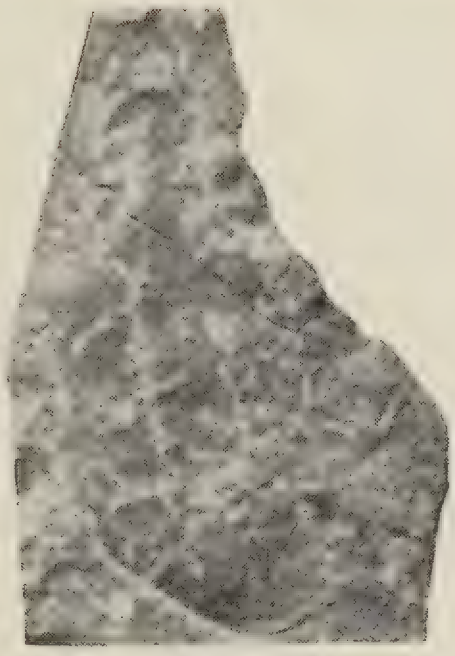
Figure 3. *P. gaspesiensis*, holotype (R.O.M.Z.P. 26805), metastoma, negative. X 1.

Figure 4. *P. atlanticus*, cotype (G.S.C. 3239c), supposed fragment of metastoma. X 1.



2

x 1/4



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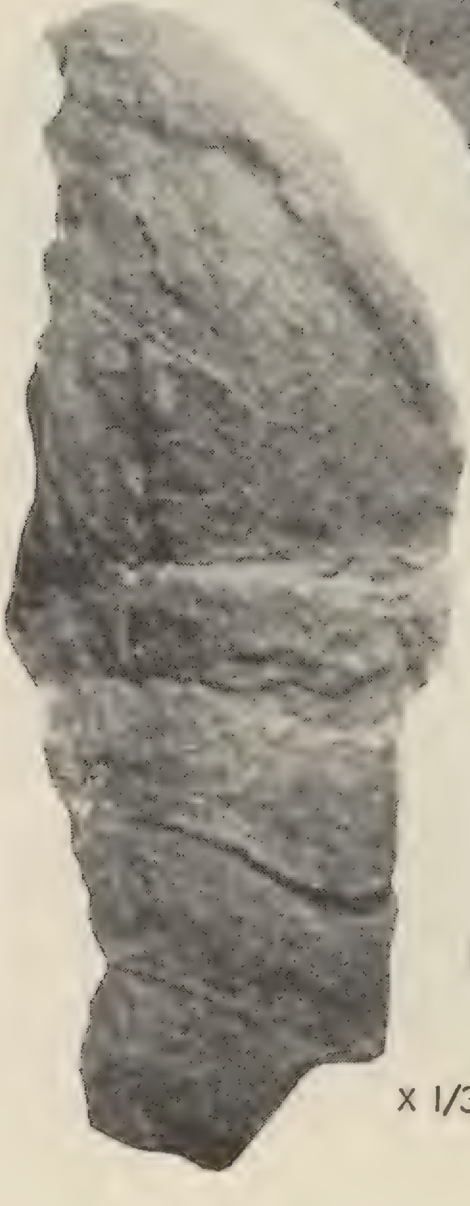
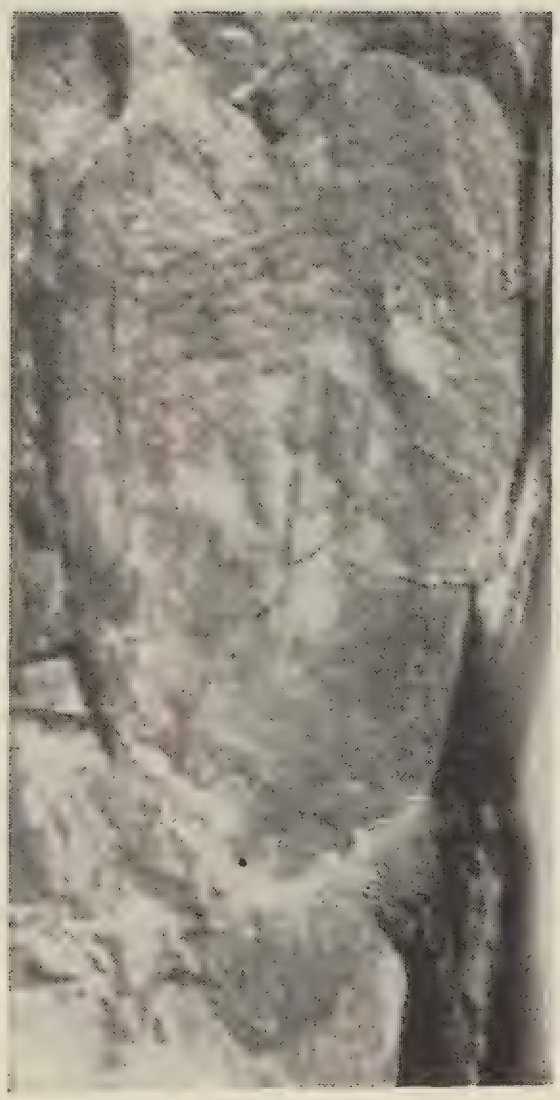


1

x 1/3



3

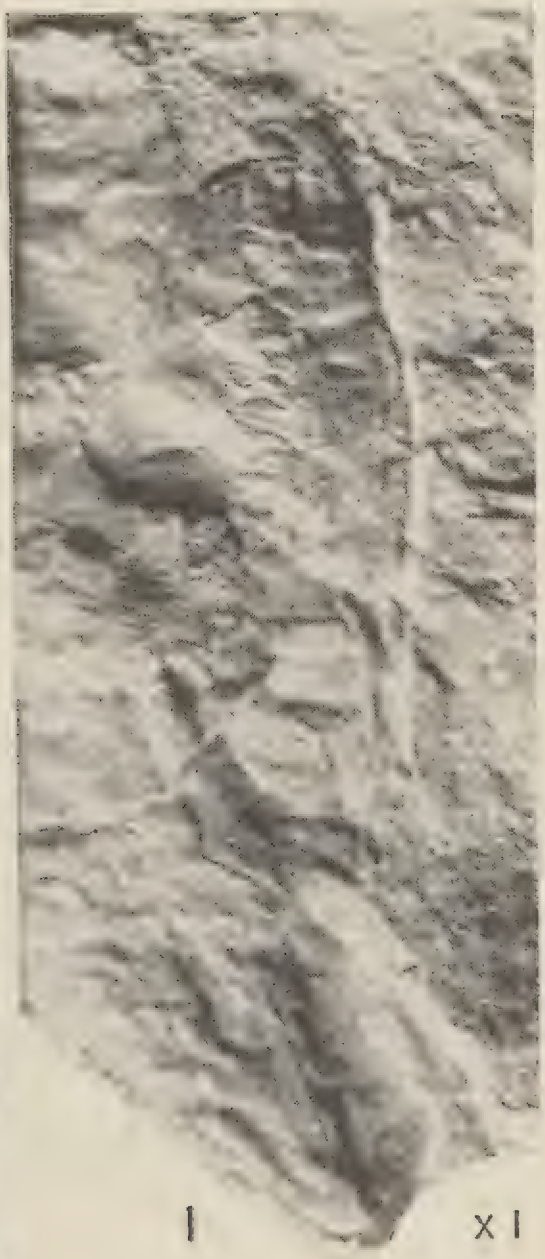
x 1

PLATE II

Figure 1. *Pterygotus gaspesiensis*, paratype (R.O.M.Z.P. 26806), chelae. X 1.

Figure 2. *P. atlanticus*, cotype (G.S.C. 3239), chele. X 1.

Figure 3. *P. gaspesiensis*, paratype (G.S.C. 10326), parts of five posterior tergites and presumed telson, negative. X$\frac{2}{3}$.



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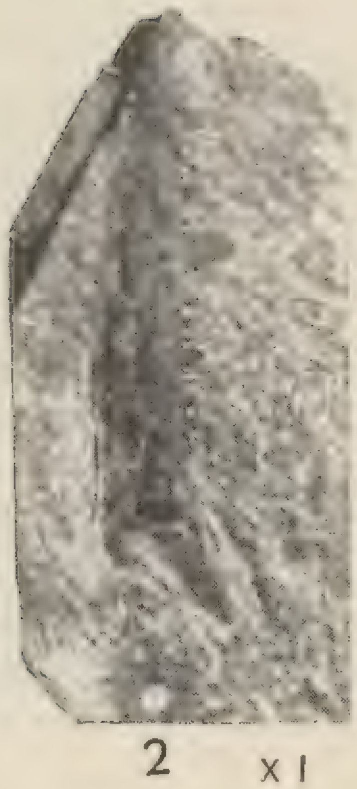

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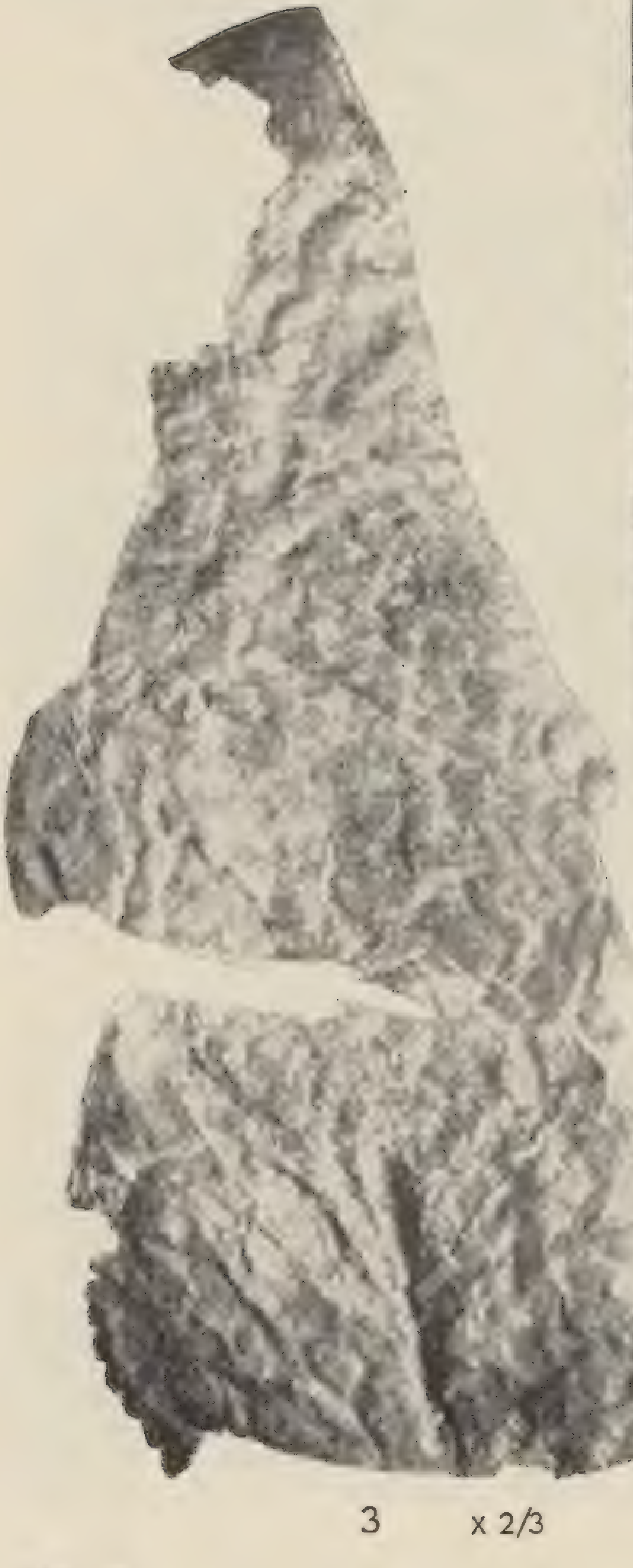

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MAMMALIAN FAUNA OF THE KISHENEHN FORMATION, SOUTHEASTERN BRITISH COLUMBIA

By Loris S. Russell

INTRODUCTION

The Kishenehn formation is exposed along the North Fork of Flathead River, in townships 34 to 37 north, ranges 20 to 22 west, Montana, and in a part of British Columbia immediately to the north. The sediments that make up the formation range from clay to coarse conglomerate and include limestone and lignite. The formation is surrounded on all sides by older rocks, upon which it rests unconformably, and is itself folded and faulted. The structural evidence indicates that the Kishenehn beds were deposited between two stages in the uplift of the Rocky Mountains. Determination of the geological age of the deposition is therefore of considerable importance.

The writer explored the Kishenehn formation to a limited extent in 1950 and obtained a new fauna of freshwater molluscs (Russell, 1952), which seemed to have their nearest affinities in the molluscan fauna of the Bridger formation (Middle Eocene) of Wyoming. Members of the expedition of 1952 were able to examine the Kishenehn beds of a much larger area, as permits had been obtained to collect fossils in Glacier National Park and Flathead National Forest, Montana, and the road had been opened farther north into British Columbia. The freshwater fauna was found at several new localities, and an entirely new fauna of land snails was discovered. Most important, teeth and bones of mammals were found at three localities, all in British Columbia. The new molluscs will be the subject of a report now in preparation. The present contribution deals with the mammalian fossils.

LOCALITIES

On the British Columbia side of the Flathead area there is no land survey comparable to the section, township, and range system of the Prairie Provinces and the United States. In my previous report (Russell, 1952) I applied a symbol to each of the Canadian outcrops, consisting of a letter and a number: thus locality E1 the first outcrop on the east side of the river north of the Boundary, W1 the first on the west side, and so on. The discovery of new fossil localities on Couldrey Creek makes it necessary to have a separate set of symbols for outcrops on this stream, and these will be designated C1, C2, etc., upstream from the junction with Flathead River. The locality designated W3 (and wrongly located) in my previous report now becomes C3.

The localities at which mammalian fossils have been found are designated under this system C2, E3, and E4. Locality C2 is on the right bank of Couldrey Creek about one mile above the mouth. It is the upstream end of a series of exposures along a steep, partly wooded valley side. At the fossil locality the beds have an apparent dip of 25 degrees due east. They consist of friable and lumpy shale, with thick beds of pebble conglomerate at the top. The fossils occur at about the middle of the exposed section, in grey, gritty clay, which breaks into large angular fragments. The fossils are mostly the shells of land snails, but fragments of bone were observed in the field, and on working over the material in the laboratory the left lower first molar of *Protadjidaumo burkei*, n. sp. was discovered.

Locality E3 (Plate I, figure 1) is on the east bank of Flathead River, 2·8 miles due north of the International Boundary. It is at the second cutbank upstream from the bridge at the Canadian Kootenay well. Heavy downfall and a thick growth of young pine make it difficult to reach this locality on foot. In the greater part of the cutbank only gravel is exposed, but at the upstream end there is a low outcrop of Kishenehn beds, consisting of reddish and grey mudstones, with lumpy masses. Fragments of bone were observed and specimens collected, some of which proved on preparation to be identifiable mammal teeth. The following were determined:

Desmatolagus sp.
Pseudocylindron silvaticus, n. sp.

Locality E4 yielded the largest series of mammalian remains. It is a large outcrop (Plate I, figure 2) on the east side of Flathead River, 8·5 miles due north of the International Boundary. It is near the former headquarters of the coal prospectors, a locality known as Butts's Cabin. Adjacent to the original log cabin there has recently been constructed a ranger's cabin for the British Columbia Forest Service. From these buildings it is about 1,700 feet along an old road to the west bank of the river. On fording at this point the fossil locality can be seen about 2,000 feet upstream. The outcrop is much frequented by deer and moose for the slightly saline seepage water. The apparent dip is upstream at the south end, and here the lower beds are exposed. They consist of clayey sandstone, overlain by grey and rusty friable shale. The fossils occur in the shale, in two beds separated by about three inches of sandy shale. Overlying the shale are thick beds of conglomerate, with boulders up to one foot in diameter. The fossils include land snail shells, fragments of bird bones, and the bones and teeth of mammals. The following mammals have been identified here.

Peratherium sp.
Thylacaelurus montanus, n. gen. and sp.
Protadjidaumo burkei, n. sp.
Paradjidaumo alberti, n. sp.
Leptotragulus? *significans*, n. sp.

AGE OF THE KISHENEHN FORMATION

In the account of the Kishenehn freshwater molluscan fauna (Russell, 1952), were pointed out the resemblances, not very close, to the molluscs of the Bridger formation of southern Wyoming, the type Middle Eocene of the mammal-bearing Tertiary on this continent. On this basis the Kishenehn formation was tentatively referred to the Middle Eocene. The considerable differences that were obvious between the Bridger and Kishenehn molluscs might conceivably have been an expression of their geographic separation. It is now evident that an age difference is also involved. Unfortunately the molluscan faunas of the Uinta and Duchesne River formations have not been described; they may prove to have marked resemblances to the Kishenehn fauna.

The very interesting fauna of terrestrial gastropods now under investigation does not supply evidence for the age of the Kishenehn formation. All of the species and some of the genera are new, and the comparisons that can be made have little significance for correlation. It is to the mammalian fossils that we must turn for a detailed determination of the geological age. That this is younger than Middle Eocene is indicated by the presence of eomyid rodents and a selenodont artiodactyl. Of the eomyids, *Protadjidaumo* was established by Burke (1934) on specimens from the Duchesne River formation of Utah. *Paradjidaumo* has been known hitherto only from the Oligocene, but it does occur in the basal portion (Pipestone Springs beds). From this part of the Oligocene the genus *Pseudocylindron* was described. *Desmatolagus*, a genus of rabbits, occurs in the Oligocene, beginning with the Pipestone Springs fauna. The new species referred tentatively to the artiodactyl genus *Leptotragulus*, of the Upper Eocene, is closer to this than to the Oligocene *Leptomeryx*. The two marsupials contribute little to the age determination. It is evident that the affinities of the Kishenehn mammalian fauna are with those of the Duchesne River formation (uppermost Eocene) and the Pipestone Springs beds (basal Oligocene). Possibly a time intermediate between these two is represented by the Kishenehn. Arbitrarily it is proposed to retain the formation in the Eocene as an uppermost part, but it could with equal merit be regarded as basal Oligocene.

PROBABLE HABITAT

The mammalian fossils so far obtained from the Kishenehn formation represent the microfauna or "quarry fauna", as distinct from the assemblages of larger mammals such as characterize many of the Eocene and Oligocene mammal-bearing deposits of Canada and the United States. Rodents predominate in the Kishenehn fauna, and the largest mammal represented is a hypertragulid artiodactyl, one of the smaller elements of the Cypress Hills fauna, for example. Students of fossil mammals in the United States mostly regard the "quarry" assemblage as representing the woodlands habitat, in contrast to that of the savannahs and open plains that seem to be implied by fossil rhinoceroses, titanotheres, the later horses, and the larger artiodactyls. The interpretation of the Kishenehn fauna as representing the woodland habitat is supported by palæogeographic evidence. The structural relationships of the formation to the older rocks, and the presence in it of coarse detritus, obviously derived from mountains much like the present Rockies, suggest that the deposits were laid down in an intermontane valley, perhaps something like the present Rocky Mountain trench. The Pipestone Springs beds of southwestern Montana occur within the mountains and carry a mammalian fauna resembling that of the Kishenehn. Here too we probably have a fauna of the mountain region, although not quite so cut off from the plains to the east. The Kishenehn formation is not unique in the habitat represented by its mammalian fauna, but it is sufficiently distinct, and distant from other deposits of the same age, to be likely to yield a large proportion of new forms.

DESCRIPTION

Class **Mammalia**

Order MARSUPIALIA

Family **Didelphyidae**

Peratherium sp.

Text-figure 1; Plate I, figs. 1, 2

Referred specimen. National Museum of Canada, Fossil Vertebrate Collection, No. 8909; fragment of right mandibular ramus with trigonid of one molar; locality E4.

Description. The jaw fragment is small, slender, and regularly tapering from rear to front. There are eleven alveoli preserved in whole or part; these are thought to represent the first two molars, the three premolars, and, by an incomplete alveolus, the canine. There is no diastema in the series. The anterior mental foramen lies directly below the posterior alveolus of the (presumed) P_1, and the posterior mental foramen below the posterior alveolus of the (presumed) M_1. The preserved trigonid, assumed to be that of M_3, is obliquely triangular in outline as seen from above, and is not compressed anteroposteriorly. The protoconid is the largest cusp. The paraconid and metaconid are subequal, but the paraconid lies well in advance of the protoconid, whereas the metaconid is almost opposite the protoconid. The protoconid is connected to the paraconid and metaconid by crests, but the internal margin of the trigonid is open through a deep cleft between paraconid and metaconid. The anterior cingulum is distinct but not prominent. Total length of the jaw fragment, exclusive of tooth, is 6·4 mm.; width of the trigonid of M_3 is 0·8 mm.; length of same is 0·8 mm.

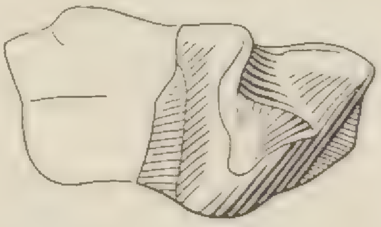

Figure 1. *Peratherium* sp., N.M.C. No. 8909, incomplete right lower molar, crown view, X 10.

Remarks. This specimen is clearly didelphyid, as indicated by the obliquely triangular trigonid and the subequal paraconid and metaconid. The reference to *Peratherium* is tentative but conforms to the practice of including in that genus the more generalized of the Eocene and Oligocene didelphyids. The size is about that of *P. innominatum* Simpson (1928, p. 6), but the protoconid is not so elevated as in that species. In comparison with Oligocene species the present specimen is slightly larger than the corresponding parts of *P. huntii* Cope (Scott and Jepsen, 1941, p. 963), but resembles it in having no diastema in the premolar series. This is apparently also true in *P. innominatum*. *P. valens* (Lambe) (1908, p. 22) is of larger size and has the paraconid noticeably smaller than the metaconid.

Thylacaelurus montanus, n. gen. and sp.

Text-figure 2; Plate II, fig. 3.

Etymology. Greek θύλακος, pouch, and ἄιλουρος, cat, that is, the cat-like marsupial; Latin *montanus*, of the mountains.

Type. N.M.C. No. 8910; fragmentary right maxilla with part of jugal and with P^3, M^1, and M^2; locality E4.

Generic and specific characters. Palatal region (and probably whole skull) short and broad. Dentition reduced; probably only two molars. P^3 with strong spur directed forward and inward. Molars triangular, with the three primary cusps well developed and with a small metaconule; only two distinct stylar cusps, apparently the third and fourth of the original five.

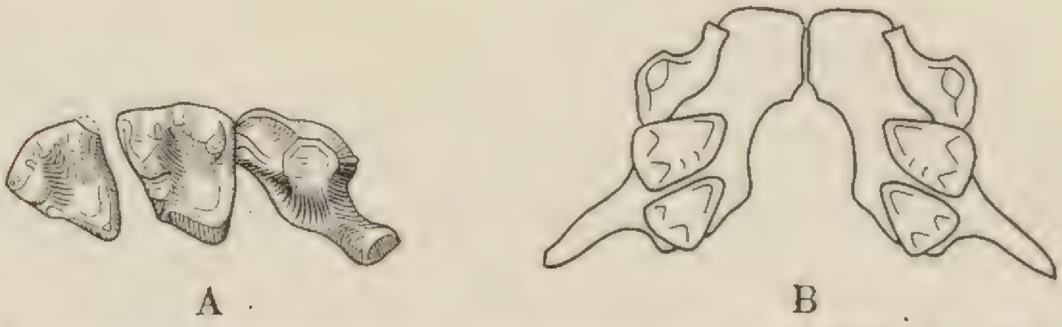

Figure 2. *Thylacaelurus montanus*, n. gen. and sp., N.M.C. No. 8910:
A, crown view of right P_3, M_1, M_2, X 5;
B, restoration of portion of palate, X 3.

Description. The P^3 is the most distinctive tooth of the dentition as preserved. It consists of a main conical, rather massive cusp, with slight posterior crest, but from the inner side of the main cusp a spur projects inward and then curves forward, terminating abruptly without any distinct cusp. There may have been a small tip broken away at the anterior end of the spur, or it may be that this portion of the tooth abutted against the P^2. This sinuous spur is a unique dental structure in the experience of the writer.

The outline of the M^1 is triangular, and as the posteroexternal angle is not produced, there is less obliquity than is usual in didelphyid upper molars. Protocone, paracone, and metacone form a symmetrical triangle, as the metacone is farther from the external margin than is the paracone. All three cusps are V-shaped, but the two external cusps are more conoid than the protocone. The area within the triangle of the three primary cusps is well basined. There is a distinct metaconule on the inner side of the metacone, but only a suggestion of a corresponding protoconule on the paracone. A small stylar cusp is present on the posterointernal side of the crown, about half-way between protocone and metacone. The anterior arm of the paracone V is suppressed, and the parastyle (first stylar cusp) is not prominent. The posterior arm of the paracone terminates in a distinct stylar cusp. Close to it, but separated by a cleft, is a similar stylar cusp on the anterior arm of the metacone V. The posterior arm terminates in the metastyle (fifth stylar cusp), which is broken but apparently was distinct.

The triangular outline of M^2 is almost symmetrical, with no production of the posteroexternal angle. Except for this, and the slightly smaller size, it resembles the M^1 in most features. The cusps and cuspules have the same disposition and relative development. There is, however, no stylar cusp on the posterointernal side of the crown.

The outer margins of the three preserved teeth form a curved outline, convex outward. The maxilla rises behind M^2, strongly suggesting that this tooth was the last of the series. Similarly the inward curvature of the P^3 suggests that it was close to the anterior end of the cheek dentition. The zygomatic arch arises opposite the contact of M^1 and M^2; in *Didelphys* the axis of the zygoma, if projected, meets the contact of M^3 and M^4. In the present specimen the palatal branch of the maxilla is broad anteriorly but restricted posteriorly by the palatine bone (or vacuity), which extends forward to a point level with the contact of P^3 and M^1. Some conception of the palate as a whole can be obtained from Figure 2B, in which the restoration of the maxillary region is attempted by adding the reversed outline of the specimen.

The dimensions of the teeth in this specimen are as follows:

	mm.
P^3, maximum length, measured obliquely	3·5
M^1, anteroposterior	2·0
M^1, transverse	2·4
M^2, anteroposterior	1·7
M^2, transverse	2·2

Remarks. The reference of this remarkable specimen to the Didelphyidae is based on the triangular form of the molars, the absence of the hypocone, and the shape and position of paracone and metacone. The shortening of the dentition, the presence of a metaconule on the molars and especially the extraordinary form of the P^3 represent departures from the usual didelphyid structure. It is possible that a family of polyprotodont marsupials not hitherto recognized is represented by this genus. The tendency of the polyprotodonts to assume form and habit paralleling those of specialized placental mammals is famous, and this may be another example. It is certainly a marked departure from the conventional opossum hitherto represented by most of the Tertiary marsupials of North America. The discovery of such an aberrant marsupial in the Kishenehn fauna gives some support to the suggestion of McGrew (1939, p. 398) "that the Tertiary didelphids would not be regarded as 'stereotyped' or 'monotonously unvaried' (Simpson, 1928) if they were adequately known."

Order LAGOMORPHA

Family **Leporidae**

Desmatolagus sp.

Text-figure 3; Plate II, fig. 4

Referred specimen. N.M.C. No. 8911; upper right first molar; from locality E3.

Description. The crown is well worn, being almost at the level of the roots on the outer side. The outline of the triturating surface is narrowly ovoid, with sharply rounded external and internal margins. Seen from front or back, the triturating surface is concave, curving from mid-width to the prominent external and internal sides. The lingual re-entrant is lost, but its vestige, a small circular lake, is present a little posterointernal from the centre of the crown. The external crescent is represented by a narrow ridge, extending from the external margin slightly in advance of mid-length, and curving slightly backward in its course to terminate in a small conical prominence a little short of the middle of the crown. A faint linear marking posterior to and parallel with this ridge may represent the posterior arm of the original crescent. The internal root is large and massive, and curves strongly backward as it runs upward. The two external roots are short, slender, and curved inward toward the internal root.

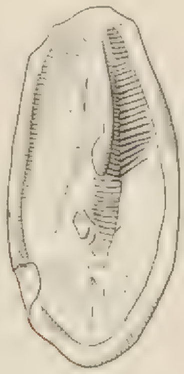

Figure 3. *Desmatolagus* sp., N.M.C. No. 8911, right M_1, crown view, X 10

The dimensions of this tooth are as follows, measured at the triturating surface: anteroposterior, 1·6 mm.; transverse, 3·4 mm.

Remarks. The extreme narrowness of the crown of this tooth, as well as the curvature of the internal root and the compression of the external crescent, indicates a representative of the *Mytonolagus-Desmatolagus-Megalagus* line. It is not possible on a single, extremely worn tooth to determine positively which of these three genera is represented. The pronounced anteroposterior narrowness of the crown has its nearest counterpart in *Desmatolagus,* although even in that genus as known the outer margin of M^1 is wider than in the present specimen. The compression of the external crescent and the better development of the anterior arm than the posterior arm of this crescent are also characteristic features of *Desmatolagus.* The pattern on the triturating surface of the present specimen has its closest parallel in the M^1 of *Desmatolagus dicei* as figured by Burke (1936, fig. 6). In size the Kishenehn tooth is closest to the M^1 of *D. gobiensis* Matthew and Granger (1923), and is smaller than that tooth in *D. robustus* Matthew and Granger, *D. dicei* Burke, and *D. gazini* Burke. It is evidently larger than the M^1 of *D. pusillus* Teilhard de Chardin (1926).

Order RODENTIA

Family **Ischyromyidae**

Pseudocylindrodon silvaticus, n. sp.

Text-figure 4; Plate II, fig. 5

Etymology. Latin for "of the woods", in reference to the probable environment.

Type. N.M.C. No. 8912; mandibular fragment with the three right molars; locality E3.

Specific characters. Size as in *Pseudocylindrodon neglectus* Burke. Lower molars with central valley narrowly open internally; posterointernal angle of crown obliquely truncated. M_3 with hypolophid incomplete, represented by a small rounded spur from entoconid.

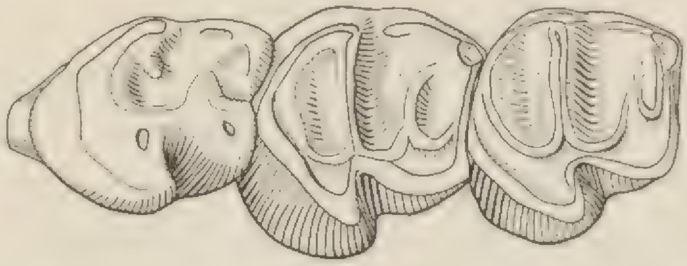

Figure 4. *Pseudocylindron silvaticus*, n. sp., N.M.C. No. 8912, right M_1 to M_3, crown view, X 10.

Description. The molars are not much worn, M_3 showing wear only on the outer cusps. M_1 and M_2 have a low rounded protoconid, from which the anterolophid and metalophid run directly inward to the metaconid. The anterior valley between them is narrow and shallow. The metaconid is situated at the end of the anterolophid and is a prominent pointed cusp, directed somewhat forward as well as upward. From the apex a marginal ridge descends posteriorly, with only a suggestion of a cuspulid on it; this ridge restricts but does not close the internal opening of the central valley. The hypoconid is a prominent spur, projecting outward and forward, and there is a deep notch into the external side of the crown between hypoconid and protoconid. From the anterointernal corner of the hypoconid, the hypolophid runs directly inward to the entoconid. Farther back, the posterolophid follows a strongly curved path along the posterior margin of the crown. The posterior valley, between hypolophid and posterolophid, is narrow and ovoid, but larger than the anterior valley. The entoconid is lower than the metaconid and has only a slight marginal ridge on its anterior side.

The M_3 differs considerably from the two preceding molars. It is smaller and has the oblique truncation of the posterointernal angle exaggerated. Anterolophid and metalophid are interrupted by a notch, especially marked on the metalophid. The posterolophid is well developed, but the hypolophid is vestigial, consisting only of a tiny knob projecting from the anteroexternal side of the entoconid. As a result the central and posterior valleys are confluent around the external side of this little projection.

The dimensions of the three molars are as follows:

	mm.
M_1, anteroposterior	1·9
M_1, transverse	2·2
M_2, anteroposterior	1·9
M_2, transverse	2·2
M_3, anteroposterior	2·1
M_3, transverse	1·8

Remarks. Pseudocylindrodon has been known previously from a single species, *P. neglectus* Burke, from the Pipestone Springs locality (basal Oligocene) of Montana. Reference of the present specimen to this genus is based on the cylindrodont molar pattern, with the central valley relatively wide and the hypoconid massive and prominent. The differences between the present species and *P. neglectus* are slight, as far as the known material indicates. It is unfortunate that the P_4, a more diagnostic tooth than the molars, is missing from the Kishenehn specimen.

Family **Eomyidae**

Protadjidaumo burkei, n. sp.

Text-figs. 5, 6; Plate III, figs. 1 to 3

Etymology. Named in honour of Dr. J. J. Burke, who made the first comprehensive study of this and related genera.

Type. N.M.C. No. 8913; broken left mandibular ramus with P_4 to M_2; locality E4.

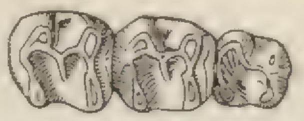

Figure 5. *Protadjidaumo burkei*, n. sp., N.M.C. No. 8913, left P_4 to M_2, crown view, X 10.

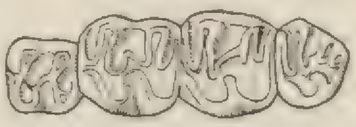

Figure 6. *Protadjidaumo burkei*, n. sp., N.M.C. No. 8914, left P^4 to M^3, crown view, X 10.

Referred specimen. N.M.C. No. 8914; crushed skull with complete upper dentition; locality E4.

Specific characters. Smaller than *Protadjidaumo typus* Burke, and with lower cheek teeth more nearly equidimensional. P_4 with two prominent and closely connected anterior cusps; mesolophid obscure. M_1 and M_2 with anterolophid feebly connected to metalophid; posterolophid not prominent.

Description. During collecting, the type specimen was split along the plane of the jaw bone, and it has not proved practicable to reunite the pieces. The cheek teeth are intact and well preserved, although it has not been possible to remove all of the matrix from the more minute recesses of the crowns.

On the P_4 the two anterior cusps are prominent and closely connected. Behind these cusps the surface falls to a broad valley, in which the mesolophid is not well developed. The posterior cusps (hypoconid and entoconid) are distinct but low and are connected by a posteriorly convex crest (hypolophid). The overhang of the M_1 and some matrix conceal the posterolophid (posterior cingulum of Burke), but this could not be very prominent. On the M_1 the anterolophid is well developed, with a median projection back towards the metalophid, interrupting the anterior valley. The posterolophid does not project as much posteriorly as it does in the M_1 of *P. typus*. The anterolophid on M_2 also projects posteriorly towards the metalophid but does not quite reach it, leaving the anterior valley narrowly open.

Dimensions of the lower cheek teeth are as follows:

	mm.
P_4, anteroposterior (approximately)	0·7
P_4, transverse	0·7
M_1, anteroposterior	0·8
M_1, transverse	0·9
M_2, anteroposterior	1·0
M_2, transverse	1·0

The incisor is preserved on another fragment of the jaw. It is a low, recumbent tooth, the posterior end lying at the base of the coronoid process. The enamelled part is 3·4 mm. in length, and the very oblique triturating surface is 2·7 mm. in length. Length of the diastema between the incisor and the P_4 is about 2 mm.

The teeth of the crushed skull are more worn than those of the lower jaw. The incisors are strongly curved, projecting down vertically from the alveoli, and with the posterior ends bulging the maxilla about 1 mm. in front of the P^4. In cross-section each tooth is asymmetrically ovoid, narrowing from front to back. The triturating surface is at an angle of about 45 degrees to the long axis of the tooth. Anteroposterior diameter is 1·2 mm., and transverse diameter about 0·4 mm. Distance from I to P^4 is 6·1 mm.

P^4 is a small, simple, quadritubercular tooth, with protoloph and metaloph. These two crests are connected anteroposteriorly by a low crest, situated a little external to the midline of the tooth. There is no mesoloph.

The M^1 has five transverse crests more or less well developed. The most anterior of these, the anteroloph, is delicate; it is connected behind with the middle of the protoloph and is vestigial external to this connection. The protoloph is well developed, with a curvature convex forward. It connects the conoid and marginal paracone with the V-shaped protocone, forming the anterior arm of the latter. The posterior arm of the protocone combines with the anterior arm of the V-shaped hypocone to form a short, centrally located mesoloph. The metaloph does not form the posterior arm of the hypocone but meets that cusp a little in advance of its centre. The metacone, which forms the external termination of the metaloph, is like the paracone in being conoid and marginal, but is a slightly lower cusp. The posteroloph is formed as an extension of the posterior arm of the hypocone along the posterior margin of the crown; it does not reach the posteroexternal angle.

The M^2 is very similar in structure to the M^1, but it is a slightly larger tooth, noticeably wider in front than in the rear. The metacone is distinctly lower than the paracone.

The M^3 is a very different tooth. It is small and is rounded-trigonal, rather than quadrate, in shape. Its peculiar features seem to result from the partial suppression of the posterior part of the crown. Anteroloph and protoloph are like those of M^1 and M^2, although the protocone is more conoid. Posteriorly the mesoloph, hypocone, metaloph, and posteroloph are all recognizable, but are vestigial structures, seemingly squeezed by the constriction of the posterior part of the crown. The metacone is almost indistinguishable as a separate cusp.

Dimensions of the right upper cheek teeth are as follows:

	mm.
P^4, anteroposterior	0·6
P^4, transverse	0·8
M^1, anteroposterior	0·9
M^1, transverse	0·9
M^2, anteroposterior	0·9
M^2, transverse	1·0
M^3, anteroposterior	0·6
M^3, transverse	0·7

Remarks. The reference of this species to *Protadjidaumo* is without question; in fact, there is little other than the smaller size to distinguish the lower teeth of the type from those of *P. typus.* Characteristic features of the genus appear in the prominent anterior cusps of the P$_4$ and in the well developed anterolophid of the molars, free at its external extremity. The crushed skull is referred to this species because the structure of the molars is that of the Eomyidae and is about what one would expect for *Protadjidaumo.* The length of the tooth row from P4 to M2 is almost exactly the same in the type lower jaw and the crushed skull. The greater wear of the upper dentition precludes the possibility of the two specimens representing the same individual.

Paradjidaumo alberti, n. sp.

Text-figure 7; Plate III, fig. 4.

Etymology. Named in honour of Dr. Albert E. Wood, an outstanding student of fossil rodents, who has given the most recent and comprehensive review of the Eomyidae.

Type. N.M.C. No. 8915; left mandibular ramus, almost complete, with I, P$_4$, M$_1$, M$_2$; locality E4.

Specific characters. Relatively small. P$_4$ constricted anteriorly; mesolophid arising from protoconid, touching but not confluent with hypoconid. Molars as in *P. minor* (Douglass).

Description. The P$_4$ has been displaced somewhat from its alveolus during fossilization, and it was not considered practicable to replace it. The crown is distinctly narrower in front than behind. The metalophid and anterolophid are reduced by wear to a triangular area, the position of protoconid and metaconid being barely discernible. From the outer (protoconid) side of the metalophid, the mesolophid curves backward and inward, just touching the hypoconid end of the hypolophid, but not connecting with it. The hypolophid is concave forward. From it the posterolophid arises at about the middle, and the two crests diverge slightly towards the internal margin. The entoconid is the most prominent cusp.

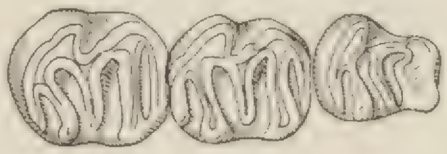

Figure 7. *Paradjidaumo alberti*, n. sp., N.M.C. No. 8915, left P_4 to M_2, crown view, X 10.

The M_1 has the five characteristic transverse crests. Anterolophid and metalophid come off together from the protoconid at the anteroexternal angle. They diverge slightly, then come together again, just touching at the anterointernal angle, and enclosing a narrow ovoid valley. The metaconid is a prominent cusp. From the posterior side of the protoconid a crest runs backward and slightly inward to meet a short spur from the hypoconid, then turns directly inward to form the long mesolophid, which almost reaches the internal margin. The hypoconid projects obliquely anteroexternally; immediately in front is an asymmetrical cleft in the tooth margin, separating this cusp from the protoconid. Posteriorly the hypoconid crest turns inward and splits to form the hypolophid and posterolophid. The hypolophid has a slightly sinuous course, swinging a little forward, then directly outward, to terminate in a prominent entoconid. The posterolophid continues along the posterior margin of the crown almost to the external margin, but does not converge on the entoconid, so that the posterior valley is open internally.

The M_2 is very similar to the M_1, the slight differences being partly due to the different degree of wear. The internal ends of anterolophid and metalophid are more closely united. The hypolophid is more sinuous, and there is a suggestion of a conulid in the middle. The posterior valley is more expanded medially and more constricted at the inner margin of the crown.

There is no sign of M_3. An area with three depressions behind M_2 may represent the alveoli, partly resorbed. It appears more likely that M_3 has been lost than that it was not yet erupted. This has influenced me to identify the most anterior tooth of the cheek series as P_4 rather than DM_4.

The dimensions of the cheek teeth are as follows:

	mm.
P_4, anteroposterior	1·1
P_4, transverse (posterior half)	0·9
M_1, anteroposterior	1·3
M_1, transverse	1·1
M_2, anteroposterior	1·4
M_2, transverse	1·2

The incisor is deep in vertical diameter and narrows in horizontal diameter from upper to lower edge. Because of this shape of the cross-section, the tooth wears to a blunt point at the anterior end. The triturating surface is very oblique, extending the full length of the exposed part of the tooth, i.e. 3·3 mm. The length of the concealed section was not determined, but as the inner surface of the jaw has collapsed just behind the P_4, it is unlikely that the incisor extends this far back. Distance between alveoli of the incisor and P_4 is 3·3 mm.

The mandibular ramus is relatively slender and, although badly fractured, is complete except for the condylar region. The coronoid process is low, and its anterior edge arises just in front of the rear of the M_2.

Remarks: It is surprising to find the supposedly advanced genus *Paradjidaumo* associated with the "primitive" genus *Protadjidaumo*. The generic assignment of *Paradjidaumo alberti* is based on the detailed resemblance of the molars to those of the previously described species, particularly *P. minor* (Douglass). Especially diagnostic is the form of the anterolophid, which arises from the protoconid at the external margin of the crown, and has no trace of an external branch. *P. minor* is from the Pipestone Springs fauna, which is of very early Oligocene age. The presence of a species of *Paradjidaumo* in the Kishenehn along with a representative of *Protadjidaumo* gives support to the opinion of Burke (1934) that the evolutionary line of *Paradjidaumo* separated from that of *Protadjidaumo-Adjidaumo* at an early stage.

Order ARTIODACTYLA

Family **Hypertragulidae**

Leptotragulus? *significans*, n. sp.

Text-figure 8; Plate III, figs. 5, 6

Etymology. Latin for "significant". The type specimen was the first Kishenehn fossil to be recognized in the field as mammalian and, being obviously from a selenodont artiodactyl, immediately indicated a younger age for the formation than had been previously suggested.

Type. N.M.C. No. 8916; fragment of right mandibular ramus with unworn M_1 and M_2, the latter not fully erupted; locality E4.

Specific characters. Lower molars about the size of those of *Leptotragulus proavus* but not so robust; cusps relatively slender. Posterior arm of protoconid reaching ectolophid; secondary crest on rear face of protoconid. Anterior arm of hypoconid not reaching posterior arm of protoconid.

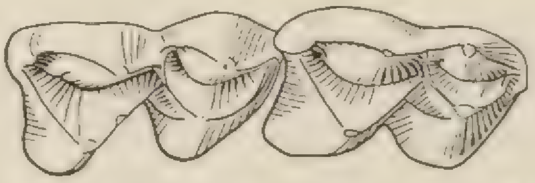

Figure 8. *Leptotragulus*? *significans*, n. sp., N.M.C. No. 8916, right M_1 and M_2, crown view, slightly restored, X 3.

Description. The two molars preserved are almost identical in appearance, except that M_1 has been slightly damaged, and M_2 is not fully erupted. All of the cusps are high and pointed, the two inner cusps being higher than the two outer. Metaconid and entoconid are oval-conoid in shape and are joined by a continuous ectolophid, which forms a double-S pattern as in *Leptotragulus proavus*. The protoconid is V-shaped, the anterior arm curving forward and inward to meet the anterior end of the ectolophid. The posterior arm of the protoconid is nearly straight, and its extremity joins the ectolophid at the low point midway between metaconid and entoconid. There is also a secondary posterior crest, which runs obliquely down the posterior face of the protoconid and terminates against the anterior arm of the hypoconid. The latter crest extends a little anterior to the point of juncture with the secondary protoconid crest but does not quite reach the main posterior crest of that cusp. The posterior arm of the V-shaped hypoconid runs straight posterointernally to terminate in a small stylar cuspule at the extremity of the crown, a cuspule that also forms the posterior termination of the ectolophid.

Owing to the broken condition of the M_1, measurements of it would not be accurate. Dimensions of the M_2 are: anteroposterior, 8·0 mm.; transverse, 4·9 mm.

Remarks. This species as known from the type specimen is clearly hypertragulid. The molars are comparable with the corresponding teeth of *Leptotragulus* and *Leptomeryx*. They resemble those of *Leptotragulus* in the sigmoid curvature of the ectolophid and the presence of a stylar cuspule at the posterior angle of the crown. Juncture of the posterior arm of the protoconid with the ectolophid is to be seen in *Leptomeryx* but not in *Leptotragulus*. As in *Leptomeryx*, the anterior arm of the hypoconid does not meet the posterior arm of the protoconid. Unique features are the secondary posterior crest on the protoconid and the absence of a median external stylid, which is present on the lower molars of both *Leptotragulus* and *Leptomeryx*.

It seems probable that an undescribed genus is represented by this species, but proof of this will require additional specimens, particularly the upper dentitions.

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PLATE I

Figure 1. Outcrop of Kishenehn clay and sandstone, locality E3, east side of Flathead River, 2·8 miles due north of International Boundary, British Columbia.

Figure 2. Large outcrop of Kishenehn clay, sandstone, and conglomerate, locality E4, east side of Flathead River, 8·5 miles due north of International Boundary, British Columbia.

1

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PLATE II

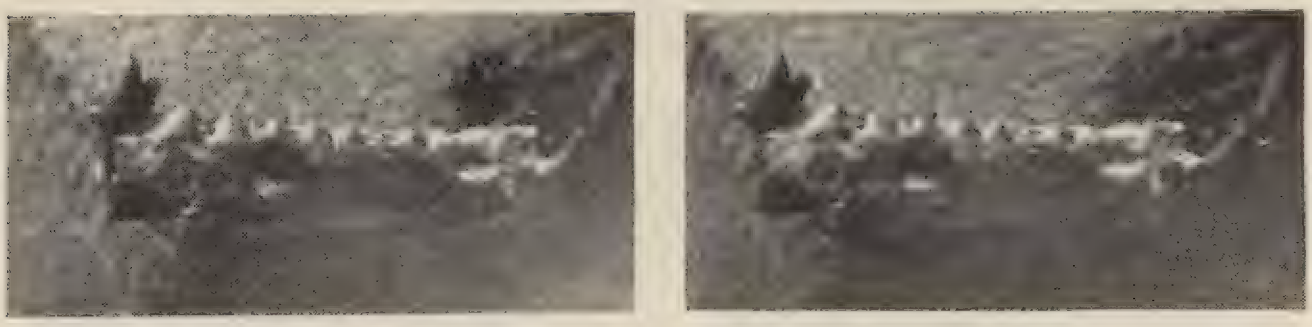
Figure 1. *Peratherium* sp., N.M.C. No. 8909, incomplete right mandibular ramus with trigonid of molar, external view, X 6.

Figure 2. *Thylacaelurus montanus*, n. gen. and sp., N.M.C. No. 8910, right maxilla with P^3, M^1, M^2, crown view, X 6.

Figure 3. *Desmatolagus* sp., N.M.C., No. 8911, right M^1, crown view, X 6.

Figure 4. *Pseudocylindrodon silvaticus*, n. sp., N.M.C. No. 8912, fragment of right mandibular ramus with M_1 to M_3, crown view, X 4.

Plate II



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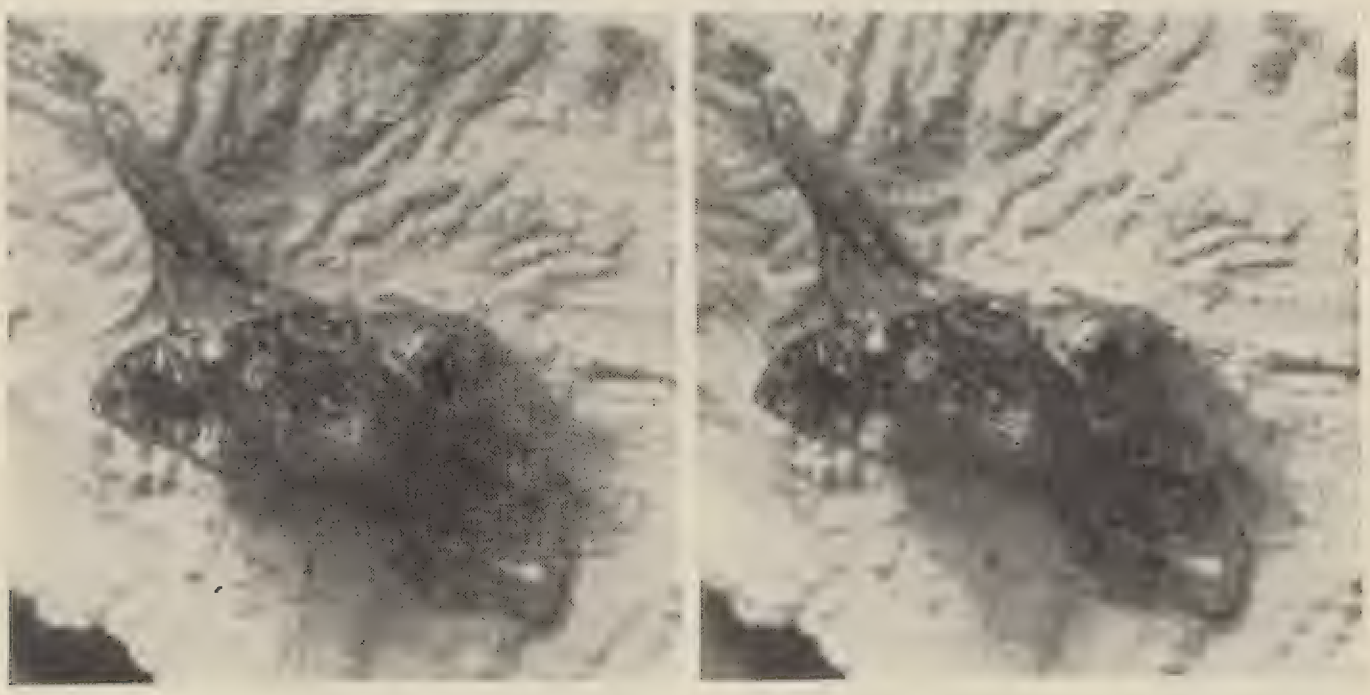

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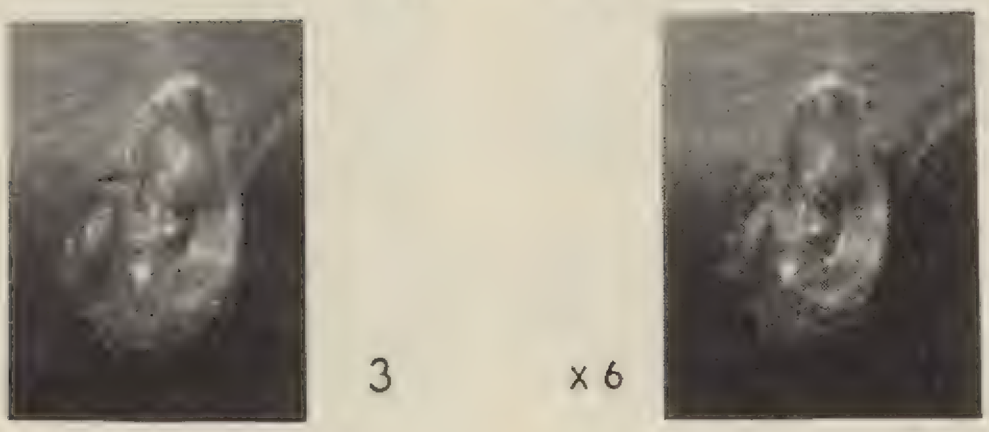

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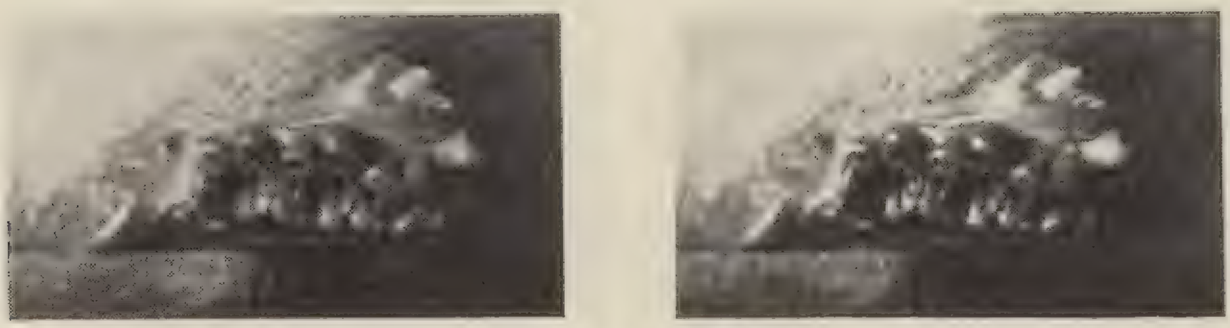

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Plate III

Figure 1. *Protadjidaumo burkei*, n. sp., N.M.C. No. 8913, fragment of left mandibular ramus with P_4 to M_2, crown view, X 8.

Figure 2. *Protadjidaumo burkei*, n. sp., N.M.C. No. 8914, portion of crushed skull showing P^4 to M^3 left, crown view, X 8.

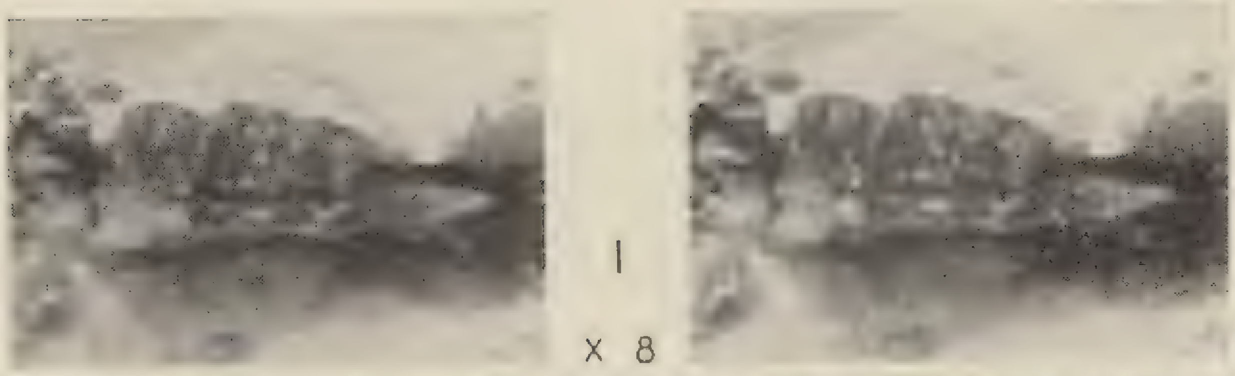
Figure 3. *Protadjidaumo burkei*, n. sp., N.M.C. No. 8914, portion of crushed skull showing P^4 to M^3 right, crown view, X 8.

Figure 4. *Paradjidaumo alberti*, n. sp., N.M.C. No. 8915, left mandibular ramus with I, P_4 to M_2, internal view, X 3.

Figure 5. *Leptotragulus? significans*, n. sp., N.M.C. No. 8916, fragment of right mandibular ramus with M_1, M_2, external view, X 2.

Figure 6. *Leptotragulus? significans*, n. sp., N.M.C. No. 8916, fragment of right mandibular ramus with M_1, M_2, crown view, X 2.

PLATE III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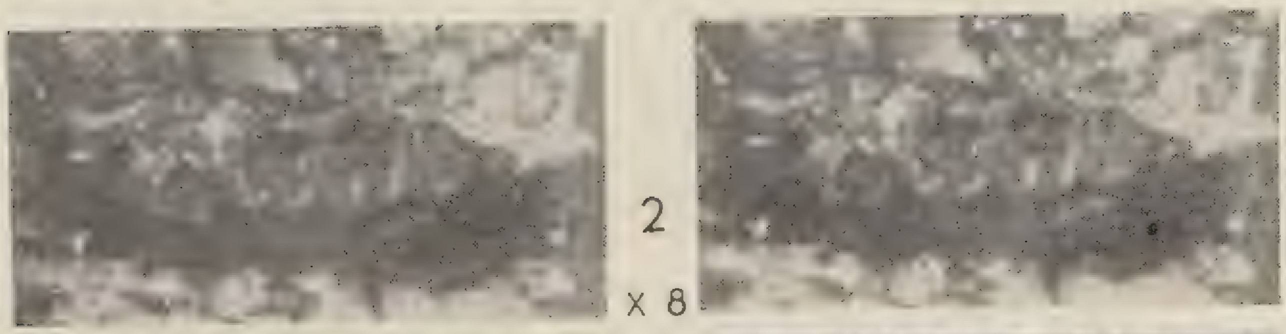
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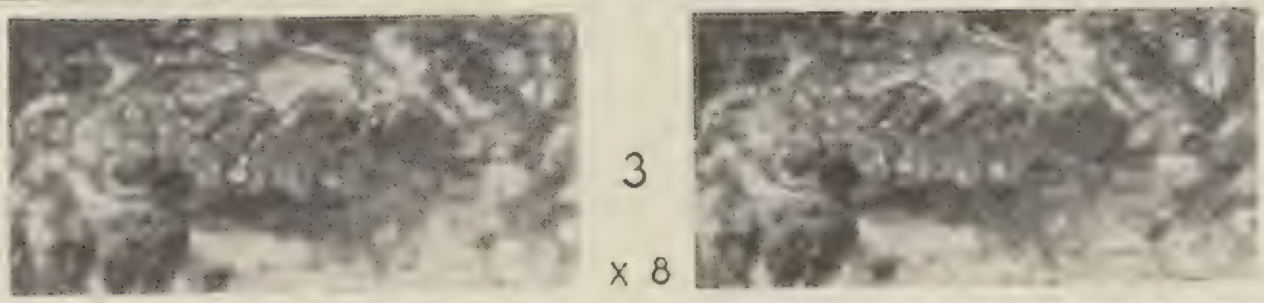
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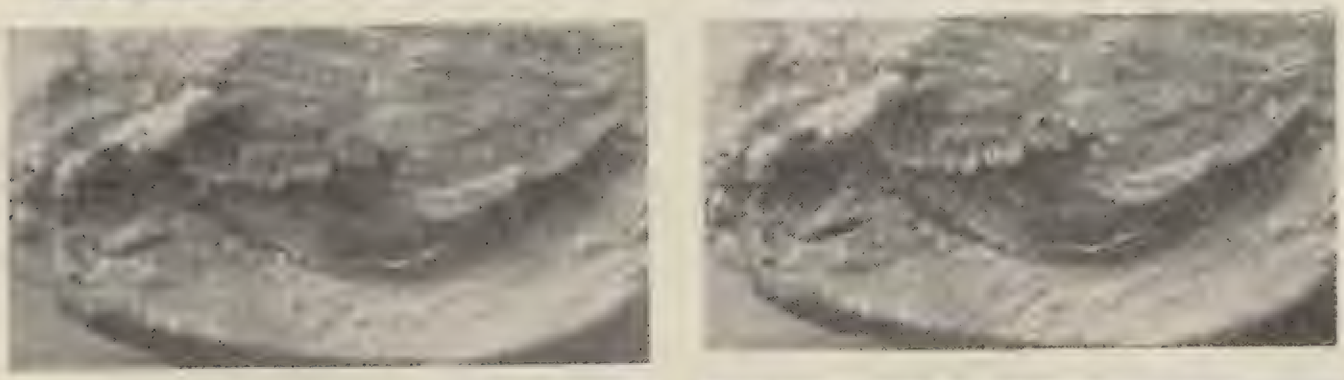
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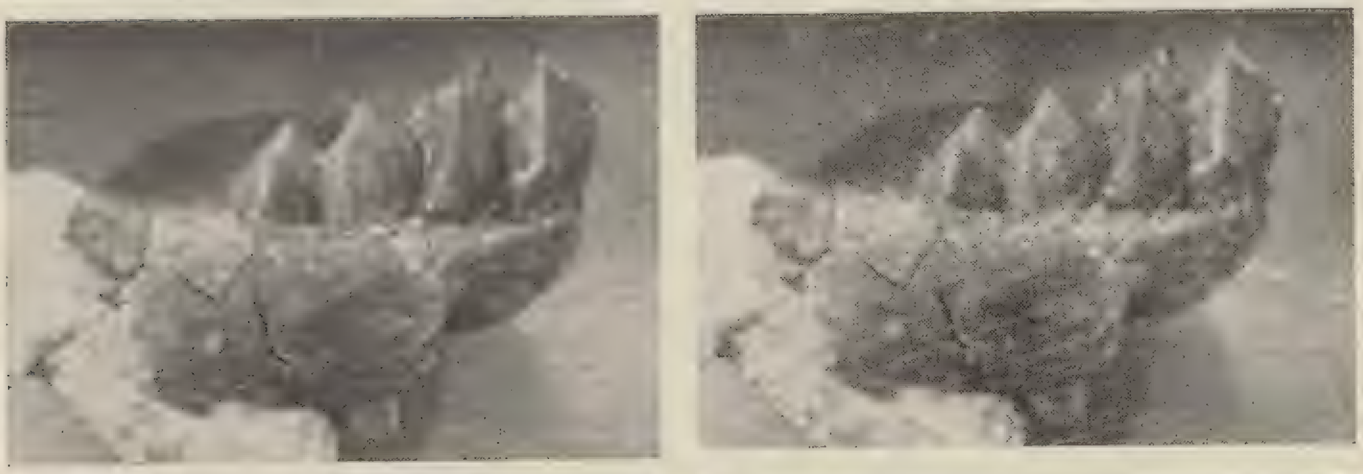
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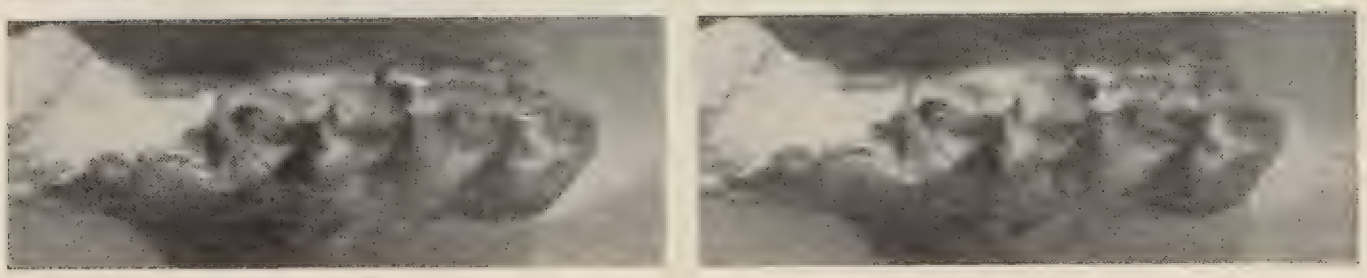
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THE DISTRIBUTION AND SPAWNING SEASONS OF BARNACLES ON THE ATLANTIC COAST OF CANADA

By E. L. Bousfield

INTRODUCTION

The present investigation was undertaken primarily to obtain additional information on the geographical and bathymetrical occurrence of adult barnacles (Cirripedia: Balanidae) and seasonal occurrence of the larvae in coastal waters of Eastern Canada. The results of this survey, combined with those of others, suggest ways in which water temperature, ocean currents, substratum, and other environmental factors jointly influence the distribution and abundance of the cirripedian species in the region under consideration.

Much is already known of the general biology, ecology, and economic importance of barnacles. The acorn type barnacle (e.g. *Balanus*) is a crustacean of small to medium size having a soft body enclosed by hard calcareous wall plates that are permanently affixed to the substratum. Two pairs of movable calcareous plates protect the aperture of the shell but are opened to permit the outward extension of the many-jointed thoracic legs during feeding and respiration. The eggs develop and hatch in the mantle cavity and the planktonic larvae (six nauplius stages and the cyprid) are free-swimming for a period of one to six weeks, depending chiefly upon water temperature and on the species. The cyprid eventually attaches by means of its paired antennae to stones, shells, or other suitable bottom substrata and shortly thereafter undergoes metamorphosis to the sessile adult form.

Adult barnacles form a conspicuous element of the bottom fauna of the entire coastal region. Some species characterize the tidal zone; others occur most frequently in the shoals and shallows whereas others are found mainly in the deeper offshore waters, even to the edge of the continental shelf, more than 100 fathoms (600 feet) in depth. The adults compete with other bottom-living animals for space, food, oxygen, and other life requirements, and are in turn overgrown and smothered by bryozoans, sponges, hydroids, tunicates, and other encrusting organisms. Barnacles are preyed upon chiefly by starfish, sea urchins, whelks, polychaete worms, and certain fishes. During the main spawning season the larvae of barnacles may constitute a very large part of the zooplankton and thus form an important source of food for plankton-feeding fishes, shrimps, and certain of the benthos.

The role of barnacles in man's utilization of the sea has always been a negative one but nevertheless of great economic importance. These animals are important fouling organisms on ships, wharves, aids-to-navigation (buoys), and underwater structures (W. H. O. I., 1952), and are serious pests of the oyster industry (Knight-Jones, 1948). They attach in large numbers to the shells of living oysters, sometimes overgrowing and smothering them, and must be removed at considerable expense of time and money before the oysters can be marketed. In the oyster-producing areas of the Gulf of St. Lawrence the ruination of artificial oyster spat collectors by newly settled barnacles is a serious problem. A knowledge of the species concerned, their life histories, spawning seasons, and environmental requirements may therefore be of great value in studies of practical methods of reducing such loss in this region.

The author is in agreement with Thorson (1950) in maintaining that, whereas average levels of factors depict conditions normally prevailing in a marine area, limiting values provide a much more precise knowledge of the manner in which distribution is influenced by the environment. It must be remembered also that the limiting levels change with the seasons and with the stage in the life history of the organism. The coastal waters of Eastern Canada are particularly well suited to a zoogeographical study of barnacles, chiefly because of the wide ranges of temperature, salinity, depth, substrata, and other environmental conditions that reach limiting levels for many of the species in this region.

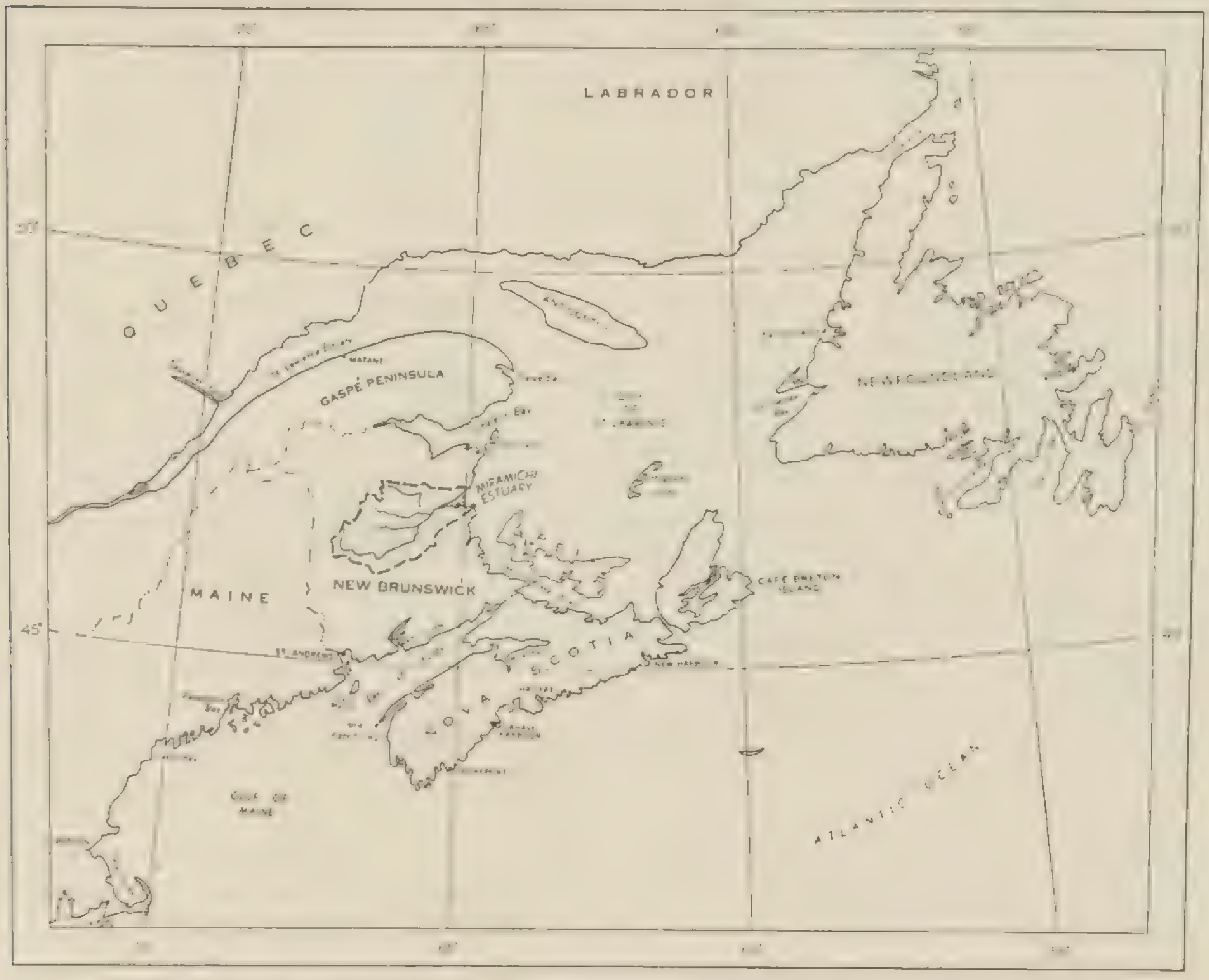

Figure 1. The Atlantic Coast of Canada showing distributional localities.

The water circulation and temperature of four main subdivisions of the Canadian Atlantic region, (1) the outer coast of Labrador and Newfoundland, (2) the Gulf of St. Lawrence, (3) the outer coast of Nova Scotia, and (4) the Gulf of Maine, are influenced to greater or lesser degree by the cold Labrador Current which originates in Davis and Hudson Straits and flows southeastward along the entire east coast of Labrador and

Newfoundland until it meets and mixes with the warm water of the Gulf Stream over the Grand Banks (Figure 1). A small branch of this current passes southwestward through the Strait of Belle Isle into the northern part of the Gulf of St. Lawrence and along the Quebec shore to the St. Lawrence estuary. Surface temperatures during the summer (July to September) in this region thus tend to remain low (less than 10°C.) at a time when those of the southwestern parts of the Gulf are high (17 to 18°C.) owing to solar heating of the Gaspé Current during its seaward movement across the Magdalen shallows (Lauzier *et al.*, 1951). The Labrador Current accounts largely for the widespread occurrence of ice in the Gulf during winter, and the melting of this ice maintains a subsurface layer of ice-cold water, 25 to 50 fathoms deep, during the summer (Huntsman, 1925).

During winter and summer alike the water that moves southwestward between the Gulf Stream and the Banks off the coast of Newfoundland and Nova Scotia is a mixture of Labrador Current and Gulf Stream, decidedly and constantly different from both (Huntsman, 1925). The surface waters are cool (10 to 15°C.) in summer and overlie very cold water near the bottom. This cool mixed water penetrates the Gulf of St. Lawrence on the north side of Cabot Strait but receives warmer water from the Cape Breton (south) side. The northern limit of the Gulf Stream migrates landward along the southwest coast of Nova Scotia, particularly during late summer and early winter (Hachey, 1939), and results in short periods of abnormally high surface temperatures and influx of animal and plant forms normally taken only in the tropics.

Cold water from the offshore areas of Nova Scotia enters the counterclockwise circulation of the Gulf of Maine and the Bay of Fundy largely in the deeper layers between the west end of Nova Scotia and Georges Bank (Bigelow, 1927). During mid-winter (February and March) temperatures at the surface over the entire Gulf are low (3 to 4°C.) and are similar at depths of 40, 100, 200 meters, and at the bottom in coastal areas (Parr, 1933). In summer (August and September) temperatures from the surface to a depth of five meters in the region of Cape Cod Bay and Georges Bank are relatively warm (17 to 18°C.), but those of the west end of Nova Scotia and the Bay of Fundy, owing to strong tidal mixing, are cool (11 to 12°C.) (Fuglister, 1947). At depths below 20 meters (65 feet), however, water temperatures are less than 5°C. in the Cape Cod region, whereas those of the northern part of the Gulf of Maine are considerably higher (8 to 10°C.).

All these patterns of water circulation and temperature, complicated geographically, bathymetrically, and seasonally, result in a very unusual southward extension of arctic and arctic-boreal cirripedes into and beyond the southernmost parts of the Canadian Atlantic Coast, and in a northward extension of a southern species into the Gulf of St. Lawrence.

The distributional data obtained prior to the turn of the century by Sir J. W. Dawson, Robert Bell, A. P. Low, J. F. Whiteaves, and other officers of the Geological Survey who dredged chiefly in the Gulf of St. Lawrence; by J. R. Willis from the outer coast of Nova Scotia; by W. Stimpson and A. E. Verrill from the Bay of Fundy; by A. S. Packard and W. A. Sterns from the outer coast of Labrador; and by many others from the Canadian Atlantic region, have been summarized by Whiteaves (1901). In view of the large amount of marine collecting during that era and of the ecological and economic importance of the barnacles, Whiteaves' records of the distribution of cirripedes in this region are surprisingly scanty. This partial hiatus may perhaps be traced to the general decline of conchological interest in the barnacles following the discovery of the nauplius and later larval stages by Thompson (1830) which definitely barred these shell-bearing animals from the phylum Mollusca and identified them with the Crustacea.

Whiteaves' catalogue is also remarkable for its attention to the deeper water species (*Balanus balanus, B. crenatus,* and *B. hameri*) and to their occurrence as fossils, doubtless a reflection of that author's primary interest in geology, but it gives few place records for the common 'intertidal' *Balanus balanoides* and it relies on a single very early record by Darwin (in 1841) for the occurrence of *B. improvisus,* by far the most abundant barnacle species in the shallows of the entire southwest portion of the Gulf of St. Lawrence. The apparent reluctance to study the shallow-water fauna during this early period is further illustrated by Bain (1890) who listed only two species, *B. crenatus* and *B. balanus* (*B. porcatus*), from Prince Edward Island, whereas the far more conspicuous *B. balanoides* was to be seen on almost every rock in the tidal zone, and *B. improvisus* was very probably brought up in large numbers in nearly every haul of the oyster fishermen's tongs.

The establishment of a marine biological station at St. Andrews, N.B., in 1906-1907 gave impetus to local collecting and to the study of the depth distribution, breeding seasons, and ecology of the marine littoral fauna. Important collections of littoral barnacles were made at St. Andrews, N.B., Prince Edward Island, and Gaspé Bay and Seven Islands, Quebec, by J. Stafford (1906-1910) and his assistants; in Halifax Harbour and the southern part of the Gulf of St. Lawrence by F. Johansen in 1917; in Miramichi Bay in 1918 and the Strait of Belle Isle in 1923 by A. G. Huntsman; in Minas Basin by A. H. Leim (1923); and in the Saint John and Miramichi estuaries by H. M. Rogers (1940). The great American conchologist H. A. Pilsbry (1907, 1916), cognizant of the need for up-to-date knowledge of the barnacles, undertook an extensive revision of the taxonomy, distribution, and ecology of the Cirripedia of the North American coastal waters, which is today the basic reference for the species of the Canadian Atlantic Coast. Kindle and Whittaker (1918) summarized existing data on the bathymetrical occurrence of Canadian Atlantic barnacles, but nevertheless, their results indicate a need for more complete information.

Early knowledge of the seasonal occurrence of the planktonic larvae of barnacles was obtained by Bumpus (1898) and Sumner *et al.* (1911) at Woods Hole; by McMurrich (1917) at St. Andrews; and by Willey (1923) in the Miramichi estuary. Later and more important studies of this nature were carried out in the Woods Hole region by Fish (1925) and Deevey (1948, 1952); in the Gulf of Maine by Fish and Johnson (1937); and in Florida by Weiss (1948). In Europe the work of Thorson (1946) has made known the breeding seasons and larval ecology of barnacles in Danish waters. The morphological and ecological studies of Bassindale (1936) and Pyefinch (1948, 1949) have made possible the determination of the species of barnacle larvae in the plankton samples of the present investigation.

Following the compilation of information on the geographical, bathymetrical, and seasonal distribution of many cirripedian species of the littoral zone, attention was focused on the manner in which the environmental factors, particularly temperature, influence survival and distribution in these forms. The studies of Allee (1923), Broch (1924), Blegvad (1929), and Bishop (1950) suggest that the northward extension of certain warm water barnacles and other littoral fauna is limited by failure to survive low water temperatures during the winter. The researches of Southward (1950) and Williams (1950) indicate that the northern limits of intertidal species (e.g. *Chthamalus stellatus*) coincide with certain minimum monthly mean air temperatures. The results of Orton (1920), Runnström (1927), and many others indicate strongly that sea temperature is a primary influence in controlling breeding and therefore distribution in marine littoral animals. The northward extension of oysters has been shown by many authors to be limited by summer water temperatures below the minimum levels required for reproduction (Korringa, 1952) which operate not only by "triggering" the release of eggs and sperm, but also by accelerating the maturation of the gonads (Loosanoff and Davis, 1952).

Ekman (1935, 1953) has distinguished between a reproductive eurythermy or stenothermy which occurs during the reproductive phase of adult life, and a vegetative eurythermy or stenothermy which occurs at other times and which may or may not coincide with the spawning period or with the maturation and ripening of the gonads. Spawning seasons are thus a result of periodicity with regard to temperature requirements in the animal itself. Madsen (1936), Thorson (1946), and others have presented evidence that the temperature critical to survival may occur in the larval stage or at metamorphosis in sessile attaching forms. The work of all these authors furnishes excellent support for the important contribution of Hutchins (1947) that the zonal boundaries of organisms, specifically illustrated in *Balanus balanoides* and *B. amphitrite*, are to be interpreted in terms of summer and winter temperatures through their control of survival and repopulation, and that four basic types of zonation may be recognized, each having distinctive combinations of summer or winter boundaries for its poleward and equatorward limits.

Considerable information on the local distribution and abundance, the rate of growth, the requirements of salinity, substratum, and food, and the control by predation, competition, and other factors has been obtained in the case of intertidal and shallow-water species of barnacles. Especially pertinent to the present study are the investigations in Europe on *Balanus balanoides* by Runnström (1925), Fischer-Piette (1932), and Moore (1934, 1935, 1936); on *Chthamalus* by Hatton and Fischer-Piette (1932), Moore and Kitching (1939), and Bishop (1950); on *B. improvisus* by van Breemen (1933); and on *B. hameri* by Moore (1935). Similar information on North American species has been obtained largely in connection with ecological studies of shallow-water marine organisms by Rice (1930), McDougall (1943), Fuller (1946), and others.

The distribution of barnacles depends largely upon the dispersal of the planktonic larvae by ocean currents. Thorson (1950) has reviewed previous studies on the seaward transport and resultant wastage of larvae of benthic marine invertebrates from coastal areas where the larvae are initially spawned. Along narrow coastal shelves where prevailing currents are offshore, species with long-lived planktotrophic larvae are evidently unable to maintain themselves. Reduction of the free-swimming period is apparently an adaptive mechanism to prevent such loss. The larvae of arctic marine invertebrates are characteristically lecithotrophic and spend only a short non-feeding period in the plankton, during which time very little dispersal by ocean currents is possible. The writer (Bousfield 1954, in press) has demonstrated that the degree of retention of barnacle larvae within estuaries and embayments of coastal marine areas depends largely upon the depths at which the various larval stages swim and upon the net direction and velocity of the currents at those depths.

The physical transport of adult barnacles by ocean currents and other agencies is frequently of importance in the spread of the species to new areas, often far removed from the place of origin. Goose barnacles attached to sargassum weed, driftwood, etc., are transported very great distances by ocean currents (Broch, 1924). Acorn barnacles are carried seawards by the action of waves and ice along the shore (Madsen, 1936). Artificial transport of adult barnacles is frequently brought about by ships (e.g. Knight-Jones, 1948) but may also be accomplished by aeroplanes (Murbarger, 1952) and possibly by birds (Nilsson-Cantell, 1948).

The results of all these previous investigations have contributed greatly to our understanding of the zoogeography and ecology of barnacles, and have also raised many other problems of geographical, bathymetrical, and seasonal distribution toward the solution of which the present study in the coastal waters of Eastern Canada provides further information. An account of the field methods used in the dredging of adult barnacles and in the sampling of the planktonic larvae has been given in previous papers (Bousfield, 1952, 1954 in press). Much of the cirripede material examined was obtained from museums and other biological institutions and through the kindness of many interested persons who collected barnacles on request. The determination of the reproductive condition of adult barnacles is based on the methods of Pyefinch (1948b). Age was determined by growth ring analysis (Kuznetzov and Matveeva, 1949), by the amount of algal impregnation of the shell (Parke and Moore, 1935), by the size, and by the superposition of specimens upon one another (Moore, 1934b, 1935a).

ACKNOWLEDGMENTS

The undertaking of the present investigation necessitated the help of many organizations and interested persons. The author is indebted to Colin L. Thacker, Miss Joan E. Sproul, Blaine L. Gregan, and many others, who through their able assistance, kindness, and interest, contributed greatly to the success of the field operations; to Dr. A. W. H. Needler and officers of the Fisheries Research Board of Canada, Atlantic Biological Station, St. Andrews, N.B., for helpful suggestions and for the loan of equipment vital to the field work; to Dr. A. G. Huntsman, Fisheries Research Board of Canada; Dr. L. W. Hutchins and Dr. A. C. Redfield, Woods Hole Oceanographic Institution; and D. C. Nutt, Dartmouth College Museum and the "Blue Dolphin" Expeditions, for providing the opportunity to examine collections of barnacles; to W. Carson, Atlantic

Biological Station; H. J. Squires, Fisheries Research Board of Canada, St. John's, Nfld.; and G. L. Hudson, Digby, N.S., for obtaining, on special request, collections of barnacles from specific localities in the study region; and to G. L. Clarke, Harvard University, and W. E. Godfrey, National Museum of Canada, for helpful suggestions and criticisms during the preparation of the manuscript.

GEOGRAPHICAL DISTRIBUTION IN THE CANADIAN ATLANTIC REGION

Synopsis of the Species

The order Cirripedia contains five suborders, three of which—the Thoracica or true barnacles, the parasitic Rhizocephalia, and the shell-boring Acrothoracica—are represented in the Canadian Atlantic region. The Thoracica are further subdivided into the Balanomorpha, or acorn barnacles, and the Lepadomorpha, or goose barnacles. Typical genera of the acorn type are the rock barnacles *Balanus*, *Chthamalus*, and *Tetraclita*, and the whale barnacle *Coronula*. The body of the Lepadomorpha is elongate and differentiated into a capitulum or body proper, and a peduncle or stalk by which the body is attached to the substratum. The goose barnacles *Lepas* and *Conchoderma* and the benthic genera *Mitella* and *Scalpellum* are typical of this group. The body of the Rhizocephalia consists mainly of a globose sac attached by rootlike outgrowths, to the abdomen of decapod crustaceans. The larval stages resemble those of true barnacles, however. The body of the shell-boring *Alcippe lampas* Hancock (Acrothoracica) is segmented and surrounded by a large mantle but without a shell. Neither the Rhizocephalia nor the Acrothoracica are included within the scope of the present study. Of the Thoracica, the acorn barnacles are the most abundant, most widely distributed, and most economically important group on the Canadian Atlantic Coast.

Suborder BALANOMORPHA

Family **Balanidae**

(i) *Balanus balanoides* (L.)

References:

(Adult Stage)	(1) Darwin, Charles, 1854, Monograph, p. 267, pl. 7, figs. 2a-2d.
	(2) Pilsbry, H. A., 1916, Monograph, pp. 182-189, pl. 44.
(Larval Stage)	(1) Hoek, P.P.C., 1909.
	(2) Bassindale, R., 1936 (Nauplius stages I–VI, cyprid, figs.)
	(3) Pyefinch, K. A., 1948a (Nauplius stages I–VI, cyprid, figs.)

Distribution. "From latitude 66°34′ north in the Arctic Ocean to the ocean coast of France and to Delaware Bay; in the Pacific—from Unalaska to Sitka" (Pilsbry, 1916).

Specimens of *B. balanoides* from the following localities on the Atlantic Coast of Canada have been examined:

Labrador—outer coast (Kauk Harbour, Hopedale, Hamilton Inlet, Port Saunders, Pack's Harbour); Strait of Belle Isle (Forteau Bay).

Newfoundland—outer coast (St. John's, Argentia); Gulf coast (Cow Head).

Quebec—north shore (Pataquan*, Seven Islands*); Gaspé coast (Rivière à Claude*, St. Bonaventure*). Field records were obtained from Carleton, east along Chaleur Bay to Percé Rock, and from Percé upriver to Matane.

New Brunswick—Chaleur Bay (Eel River*, Heron Island*, Bathurst*, Grande Anse, Shippigan*, Miscou Harbour*); Gulf coast (Tracadie*, Neguac*, Miramichi Bay*, Rexton*, Shediac); Bay of Fundy (Grand Manan, St. Andrews*, Beaver Harbour*, Saint John*, St. Martins*).

Prince Edward Island—Ellerslie*, New London*, Tracadie*, Souris*, Newport Ferry*, Charlottetown*, Egmont Bay*, Cascumpeque Bay*.

Nova Scotia—Gulf coast (Tidnish*, Cheticamp); outer coast (Louisburg*, New Harbour*, Sober Island*, Halifax*, Peggy Cove*, Mahone Bay*, Lunenburg*, LaHave*, Liverpool*, Lockeport*, Argyle*, Port Maitland*, Cape St. Mary*, Brier Island*); Bay of Fundy (Digby Gut*, Walton*, Noel*, Bass River*, Economy Point*, Sand River, Joggins Mines).

Records and specimens contained in the buoy collections of the Woods Hole Oceanographic Institution from the following localities in the Gulf of Maine and New England Coast have been examined:

Eastport, Machias, Mt. Desert Island, Penobscot Bay, Casco Bay, Boston Harbour, Cape Cod Bay, Woods Hole, Narragansett Bay.

(ii) *Balanus crenatus* Bruguière

References:

(Adult Stage) (1) Darwin, Charles, 1954, Monograph, p. 261, pl. 6, figs. 6a-6g.
(2) Pilsbry, H. A., 1916, Monograph, p. 165-175. pls. 39, 40.

(Larval Stage) (1) Herz, L. E., 1933. (Nauplius I—VIII, cyprid, figs.)
(2) Bassindale, R., 1936 (Nauplius I—VI, cyprid, figs.)
(3) Pyefinch, K. A., 1948a. (Nauplius I—VI, cyprid, figs.)

Distribution. "Arctic Ocean; North Atlantic south to Long Island Sound; Bering Sea and North Pacific south to Santa Barbara, California, and Northern Japan. British Pliocene; Pleistocene of Norway, Canada, Maine, and Alaska." (Pilsbry, 1916).

Specimens of *B. crenatus* from the following localities on the Atlantic Coast of Canada have been examined:

Labrador—outer coast (Nain, Cape Porcupine, C. Harrigan, Hamilton Inlet, Lake Melville).

Newfoundland—outer coast (Grand Banks (numerous localities), Argentia); Gulf coast (Corner Brook).

Quebec—Gaspé coast (Gaspé Bay*, Rivière à la Madeleine*).

New Brunswick—Chaleur Bay (Bathurst*, Grande Anse*, Shippigan*, Lameque*, Miscou Harbour*); Gulf coast (Tracadie*, Miramichi Bay*, Rexton*); Bay of Fundy (St. Andrews*, Beaver Harbour, Saint John*).

Nova Scotia—outer coast (Halifax*, Mahone Bay*, Port Maitland*, Brier Island*); Bay of Fundy (Digby Gut*, off Hillsburn*, Hampton*, Scotsman Bay, Noel*, Economy Point*).

Prince Edward Island—Charlottetown*, Souris*, New London*, Ellerslie*.

Buoy collections of the Woods Hole Oceanographic Institution contains specimens of *B. crenatus* from Eastport, Maine, south along the New England coast to the mouth of the Hudson River.

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* Specimens contained in the collections of the National Museum of Canada.

(iii) *Balanus improvisus* Darwin

References:

(Adult Stage) (1) Darwin, Charles, 1854, Monograph, p. 250, pl. 6.
(2) Pilsbry, H. A., 1916, Monograph, pp. 84-88, pl. 24.
(Larval Stage) (1) Munter and Buchholz, 1869. (Nauplius I—II, fig.)
(2) Tengstrand, G., 1931. (Nauplius I—VI, cyprid, figs.)
(3) Lucks, R., 1940. (Nauplius IV—VI, cyprid, figs.)

Distribution. "Scotland to the ocean coast of France; Mediterranean, Black Sea and Red Sea. In America, Nova Scotia to S. Patagonia (Darwin)." (Pilsbry, 1916.)

The single record of *B. improvisus* from the Atlantic Coast of Canada given by Pilsbry (1916) was that of Darwin (in 1841) from Nova Scotia. In 1918 Dr. A. G. Huntsman collected specimens in the Miramichi estuary. N.B., later reported upon by both him and Rogers (unpublished MS.), Specimens collected in 1921 by Dr. A. H. Leim from Bass River, Minas Basin, have been examined by the writer. During the present investigation of 1950 and 1951 the range of this species was extended north to the head of Chaleur Bay and to bays and estuaries along the entire coast of Nova Scotia. *B. improvisus* is also expected to occur in the Bras d'Or Lakes (Cape Breton Island), and on the Gulf coast of Newfoundland (St. George Bay, Bay of Islands).

Specimens in the National Museum of Canada from the following localities have been examined:

New Brunswick—Chaleur Bay (Campbellton, Eel River, New Mills, Bathurst, Caraquet, Shippigan, Lameque, Miscou Harbour); Gulf coast (Tracadie, Miramichi Bay, Rexton, Richibucto, Shediac); Bay of Fundy (Tidal Cove, near St. Andrews); Saint John estuary (Navy Island, Reversing Falls, Belmont Beach).

Prince Edward Island—Ellerslie, Charlottetown, Newport Ferry, Tracadie, New London, Cascumpeque Bay, Egmont Bay (Higgins Wharf).

Nova Scotia—Gulf coast (Tidnish, Pugwash, Malagash Point); Outer coast: (New Harbour, Liverpool, Port Maitland); Minas Basin: (Noel, Bass River, Economy Point).

Buoy collections from the Gulf of Maine in the Woods Hole Oceanographic Institution include specimens from Penobscot Bay, Isles of Shoals, Newburyport, and Boston Harbour. Pilsbry (1916) gives numerous localities from Massachusetts south to Maryland, Georgia, and Jamaica; McDougall (1943) from Beaufort, N.C., and Weiss (1948) from Florida. The "split" distribution of *B. improvisus* on the American Atlantic Coast is thus similar to that earlier described by Ganong, (1890) in the oyster (*Crassostrea virginica*), the hard-shell clam (*Venus mercenaria*) and other southern "Virginian" invertebrates that are abundant north to Cape Cod and in the southwest part of the Gulf of St. Lawrence but occur only at isolated localities in the intervening Gulf of Maine and outer coast of Nova Scotia.

(iv) *Balanus balanus* L.

References:

(Adult Stage) (1) Darwin, Charles, 1854, Monograph, (as *B. porcatus*) p. 256, pl. 6, figs. 4a-4e.
(2) Pilsbry, H. A., 1916, Monograph, pp. 149-162, pls. 33,-35.
(Larval Stage) (1) Bate, C. Spence, 1851 (Nauplius II).

Distribution. "Arctic and North Atlantic Ocean, from 80° N. Latitude, Franz Joseph Archipelago, to the English Channel, and in America south to Nantucket and Long Island Sound. Not located off the Grand Banks of Newfoundland" (Pilsbry, 1916). Also bipolar: New Zealand and Tierra del Fuego (Ekman, 1953).

Records of *B. balanus* from the following localities on the Atlantic Coast of Canada exist:

Labrador—specimens examined from Nain, Cape Harrigan, C. Porcupine, Hamilton Inlet, Strait of Belle Isle, ("Blue Dolphin" Expeditions) 1949-1951.

Gulf of St. Lawrence—Whiteaves (1901), several localities. Gaspé Bay (Stafford, (1906–1910). H. M. Ami, 1899)*; Orphan and Bradelle Banks (H. M. Ami, 1899)*; Anticosti Island (Pilsbry, 1916)*; off the Miramichi estuary, on *Buccinum* sp. (A. G. Huntsman coll., 1918).

Outer coast of Nova Scotia—specimens examined from Halifax Harbour, Artimon Bank*.

Bay of Fundy—Port Maitland (bell buoy)*, scallop beds (40 fathoms) at the 'Hour Ground' off Digby and Hillsburn, N.S.*

Gulf of Maine—Buoy collections in the Woods Hole Oceanographic Institution contain specimens from Eastport, Me., Penobscot Bay, Casco Bay, Boston Harbour, and Cape Cod Bay.

Balanus balanus is an arctic and sub-arctic species ranging farthest northward of any of the balanoid barnacles. It extends southward in the cold Labrador current into the Gulf of St. Lawrence where it is probably most abundant along the north shore (Quebec coast) and also in the St. Lawrence estuary upriver to the Saguenay fiord, and in deeper water off the mouths of the Miramichi and other estuaries of the southwest part of the Gulf. Though widely and abundantly distributed in the Gulf of Maine and outer part of the Bay of Fundy and along much of the outer coast of Nova Scotia, it was not observed in many lots from the Grand Banks of Newfoundland.

(v) *Balanus hameri* (Ascanius)

References:

(Adult Stage) (1) Darwin, Charles, 1854, Monograph, p. 277, pl. 7, figs.
(2) Pilsbry, H. A., 1916, Monograph, pp. 205-210, pl. 53.

(Larval Stage) — No published descriptions or figures exist to date.

Distribution. "Northern Europe (including Iceland) south to the English Channel; in America, Nova Scotia to the mouth of Chesapeake Bay, 16 to 167 fathoms, southward only in deep water; none on the Grand Banks of Newfoundland". Abundant in the Pleistocene of Canada—New Brunswick and Maine, upriver to Montreal, Quebec; Pleistocene of Greenland (Pilsbry, 1916).

Specimens of *B. hameri* from the following localities on the Atlantic Coast of Canada have been examined:

Labrador—Hamilton Inlet, Rigolet (more than 50 specimens collected in 10 fathoms, July 21, 1921, by E. M. Kindle), Nat's Discovery Point, and four other localities (more than 60 specimens collected in 30 to 100 fathoms, July and August, 1950 and 1951, "Blue Dolphin" Expeditions).

Newfoundland—south coast (Fortune Bay, more than 50 specimens, 50 to 100 fathoms, June, 1951, and April, 1952, "Investigator II" Coll.)*, Grand Banks, Southeast of Cape Race, 40 fathoms, April, 1951, 1 specimen.

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* Specimens contained in the collections of the National Museum of Canada.

Nova Scotia—outer coast (New Harbour*, Lunenburg*, Port Maitland*); Pilsbry (1916) gives records from LaHave, Brown's, and Sable Banks, N.S.; Bay of Fundy ('Hour Ground' off Hillsburn, 35 to 40 fathoms, June, 1950, 10 specimens*; also 10 miles off Digby Gut, 46 fathoms, May-June, 1951, 20 lots (G. L. Hudson coll.)

Gulf of Maine—Buoy collections in the Woods Hole Oceanographic Institution contain specimens from the following localities: Eastport, Machias, Jonesport, Mt. Desert Island, Penobscot Bay, Isles of Shoals, and off Cape Cod.

Balanus hameri is an offshore species of the coastal plain, living in moderately deep, cold salt water. It ranges from southern Labrador (Hamilton Inlet), Newfoundland, and along the outer coast of Nova Scotia and in the Gulf of Maine south to Cape Cod and in deep water to Cape Hatteras, but does not occur in the Arctic.

(vi) *Other Balanomorpha*

Three species of barnacles of the littoral zone, *Balanus eburneus* Gould, *B. amphitrite niveus* Darwin, and *Chthamalis fragilis* Darwin, normally occur from the Gulf of Mexico north to Cape Cod and the southern part of the Gulf of Maine. These species might also be expected in the southwest part of the Gulf of St. Lawrence. Water temperatures during the summer are fully as high in the Gulf as at Woods Hole, Cape Cod (Fish, 1925) where these species grow and reproduce successfully. The principal factor restricting the three barnacles from the Gulf is probably the winter water temperature which is close to the freezing point during the five-month period, December to April inclusive, and is accompanied by severe icing in the shallows. At Woods Hole, on the other hand, such low temperatures occur only in certain years and then only for relatively short intervals in February and early March, and icing is usually light or entirely absent. Continued amelioration of temperatures in the northern hemisphere may eventually result in a northward spread of these barnacles to Canadian waters as has already been demonstrated by the green crab, *Carcinides maenas*, formerly restricted south of Penobscot Bay but now occurring in Passamaquoddy Bay in Canadian waters.

Balanus eburneus Gould, the ivory barnacle, is a moderately large species (26 mm. in basal diameter) ranging north from the Caribbean coast of South America to Salem, Massachusetts, in shallow water, from just above the low tide line to depths of about 100 feet (Pilsbry, 1916). Like *B. improvisus*, which it closely resembles in appearance, *B. eburneus* is found chiefly in brackish bays and estuaries. At Woods Hole near the northern limit of its range, nauplii are released during the second week of June and the cyprids commence settlement about seven to ten days later, continuing in abundance until mid-July (Grave, 1933). Fish (1925), however, found the larvae most abundant in August and September, indicating that two generations per year may occur in the Woods Hole area. At Beaufort, N.C., peak attachment takes place in July and October (McDougall, 1943). In Biscayne Bay, Florida, attachment is continuous almost the year round, but is heaviest from May to November (Weiss, 1948).

Balanus amphitrite niveus Darwin is a small barnacle, less than 10 mm. in basal diameter, ranging north from the Gulf of Mexico to Vineyard Sound (Woods Hole) in shallow bays and estuaries from the mid tide line to depths of more than 30 fathoms (180 feet) and in salinities somewhat higher than those of *B. improvisus* and *B. eburneus* (Pilsbry, 1916). The spawning season occurs in June and July at Beaufort, N.C. (Visscher, 1928), and attachment is heaviest in July and August and ceases in December (McDougall, 1943). In Florida the attachment of cyprids continues the year round but is heaviest from March to November (Weiss, 1948). *Balanus amphitrite niveus* is an important fouling organism, widely distributed by ships in tropical and subtropical latitudes.

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* Specimens contained in the collections of the National Museum of Canada.

Chthamalus fragilis Darwin is a small (5 mm. in basal diameter) species occurring in the tidal zone from the West Indies north to Woods Hole mainly along the outer coast and in much higher average salinities than the previous species. *Chthamalus* lives higher up in the tidal zone than does *Balanus balanoides* but overlaps at mid tide level. At Beaufort, N.C., the main spawning takes place in June, and attachment in July through September. At Woods Hole the larvae were taken in surface tows by Fish (1925) in August.

(vii) *Goose Barnacles*

Several species of goose barnacles (Lepadomorpha) occur regularly in the Gulf Stream off the coast of Nova Scotia and Newfoundland. During the temporary shoreward migrations of the Gulf Stream, particularly in late summer and early winter, large numbers of adult goose barnacles attached to driftwood and other floating debris are transported into coastal regions. The larval stages are probably also abundant at that time, for eggs in advanced stages of development have been taken in adult goose barnacles which drifted ashore at Woods Hole in mid August (Sumner *et al.*, 1911). The cyprids commonly attach to buoys in coastal waters of western Nova Scotia, and the young adults are able to survive and grow there during the winter.

Lepas anatifera L. is the most abundant goose barnacle on the American Atlantic Coast, occurring on driftwood and other floating debris (Pilsbry, 1907). Specimens in the National Museum of Canada (identified by H. A. Pilsbry) were taken at Green Bay, N.S., Campobello Island, N.B., and Entry Island, Magdalen Islands, by F. Johansen, 1917.

A single specimen (capitulum 17 mm. in length) was taken by the writer, June 26, 1950, from a bell buoy at Cape St. Mary, western Nova Scotia.

Lepas hilli Leach has been taken at LaHave Bank off southwestern Nova Scotia, and at Grand Manan, Bay of Fundy (Pilsbry, 1907). Specimens in the National Museum of Canada were collected by the writer from buoys at the following localities: New Harbour, N.S., July 5, 1950, Lahave Harbour, July 6, 1950, and Cape St. Mary, June 26, 1950. About thirty large specimens, capitulum 15 to 35 mm. in length, were taken from a buoy at Brier Island, N.S., June 26, 1950.

LOCAL DISTRIBUTION

Specific differences in the ecological requirements of *Balanus balanoides*, *B. crenatus*, and *B. improvisus* are indicated by differences in the distributions of the adult barnacles in local areas of the study region, such as the shallow Miramichi estuary of eastern New Brunswick. This tidal estuary, 50 miles long, and consisting of the inner narrow river and the outer bay which broadens towards its mouth, is the region in which the entire fresh-water drainage of the Miramichi watershed, 5,450 square miles in area, meets and mixes with the salt (27⁰/₀₀) water of the Gulf of St. Lawrence (Figures 1, 2). The principal features of the topography, hydrography, and ecology of this easily accessible, shallow, protected estuary have already been described by the writer (Bousfield, 1954 in press). Also discussed is the probable control of the distribution of the three species of barnacles through the action of the environment on the dispersal of the planktonic larval stages, the availability of suitable substrata at the time of attachment, and the survival of the adults subsequent to larval metamorphosis.

The principal ecological factors influencing the distribution of barnacles in the Miramichi may be reviewed briefly. At all times a well-marked gradient of salinity extends from the salt water of the Gulf (27⁰/₀₀) up the estuary to the fresh water of both branches of the river above Newcastle and just below the head of tide. Vertical gradients of salinity in the main river are also very steep; salinities at the surface are frequently 10⁰/₀₀ less than those at a depth of 25 feet. Over much of the bay this difference is still about 5 to 6⁰/₀₀, but out in the Gulf only 1⁰/₀₀.

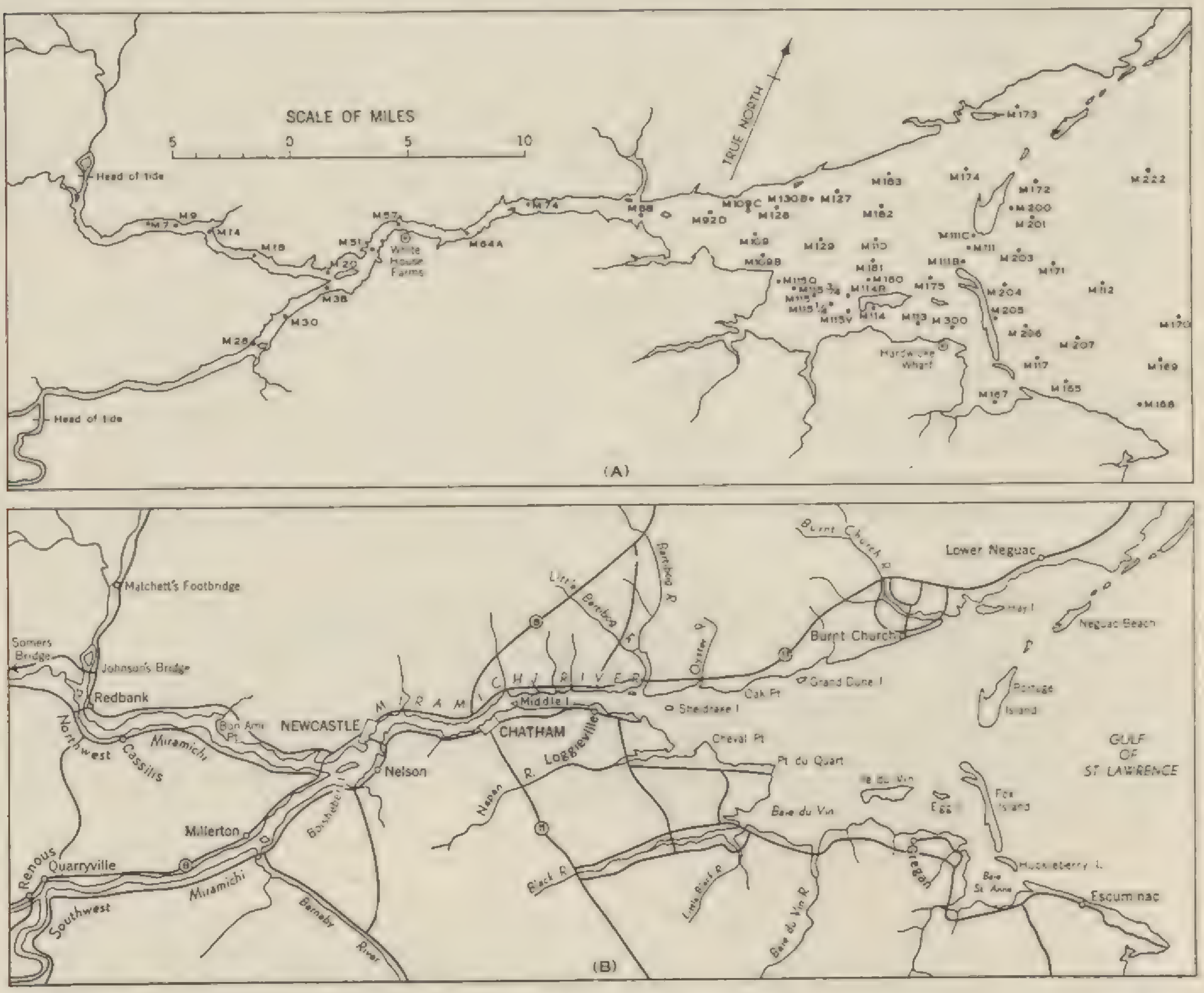
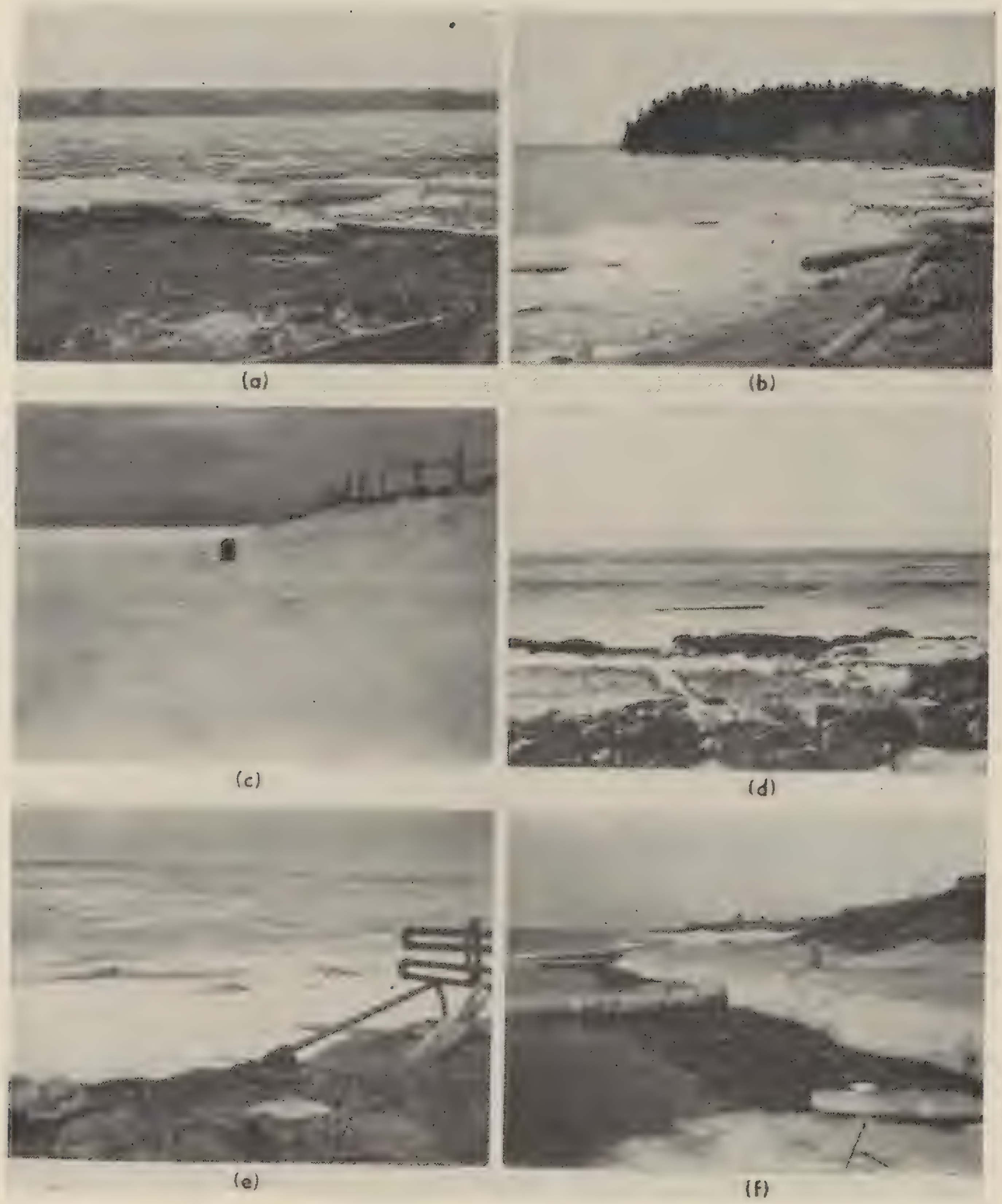


Figure 2.. Topographical features of the Miramichi Estuary
(A) Principal hydrographic stations, 1951.
(B) Place names, rivers, and roads (courtesy R. A. McKenzie, Chatham, N.B.).

PLATE I



The break-up of ice in the Miramichi Estuary.

(a) River Ice near Newcastle, April 12, 1951.
(b) Shore Ice, White House Farms, April 12, 1951.
(c) Gregan Shore, March 11, 1952.
(d) Gregan Shore, sea ice, April 14, 1952.
(e) Gregan Shore, sea ice, April 26, 1952.
(f) Gregan Shore, ice foot, April 29, 1952.

While horizontal and vertical gradients of water temperature corresponding to those of salinity are almost invariably present, the magnitude of the seasonal range of temperature is very much greater and is of primary importance to the survival of the marine fauna in this estuary. The annual cycle of water temperature in the shallows of the estuary is marked by a prolonged high (19 to 20°C.) during July and August, by a prolonged low (close to the freezing point) in winter, and by a rapid rise and fall during the spring and autumn seasons respectively.

The high summer temperatures permit spawning in many southern animals which are near the northern limit of their geographical distribution in this region, but at the same time they are lethal to stenothermal arctic forms which do not occur there. The occurrence in the Gulf of St. Lawrence of many species of "Virginian" marine animals which require relatively high-water temperatures for reproduction has been the subject of several papers (i.e. Ganong, 1890; Sullivan, 1948). The low winter temperatures, on the other hand, permit spawning in arctic-boreal eurythermal species but are lethal to many stenothermal warm-water forms. The importance of winter freezing in limiting the distribution of shallow-water marine animals has also been carefully investigated (e.g. Allee, 1923). Nevertheless, it is felt that a brief description of the severity of winter icing in the Miramichi estuary is particularly helpful to an understanding of the effect of this factor on the distribution of barnacles in the particular study region.

The extent of the ice formation in the Gulf of St. Lawrence during the winter has been reviewed by Stephenson (1953, in press). Although much of the Gulf ice is formed *in situ*, about 50 per cent comes from the St. Lawrence River and a large amount works in from the Labrador Current via the Strait of Belle Isle. Ice appears in the harbours and bays in late December and forms an ice foot along the shore which is frozen fast to the substratum and does not rise and fall with the tide. In the Miramichi estuary the surface is frozen to a depth of about two feet from December until mid-April. The break-up of ice takes place during April, and by May 1 the ice has completely disappeared (Plate I). Owing to the greater penetration of salt water along the north than the south side of the bay, in accordance with the effect of the earth's rotation on the circulation, the river and south side of the bay are frozen over for a longer period than the Gulf and north side of the bay.

Northerly gales may force Gulf ice into great pressure ridges along the shore, but these fall flat when the wind changes. The grinding action of the ice ramparts along the outer coast is severe, but inside Miramichi Bay it is much less so owing to the protection afforded by locally formed shore ice. Sometimes, however, pressure ridges of ice inside the bay form huge ramparts which tower more than 30 feet in the air. These ramparts, extending to the bottom, are pushed back and forth by wind and tidal currents, severely scouring the shoals and bars, and resulting in great destruction of shellfish beds and of barnacles attached to the bivalves.

When ice masses break away from the bottom at high tide, they carry with them stones, shells, debris, and bottom organisms which are later dropped when the ice melts. The attached organisms, including barnacles, may sometimes land in more favourable parts of the estuary, but more often they are transported outside into the unfavourable conditions of the Gulf of St. Lawrence.

The distribution of barnacles in the Miramichi estuary was determined mainly from dredge hauls at the stations indicated in Figure 2 and at many test stations at intermediate locations, and from collections along the shore, all during the summer seasons of 1950 and 1951 (Figure 3).

Balanus balanoides was collected on rocky outcrops, boulders, and wharf pilings, but was rarely taken in dredge hauls, except in very shallow

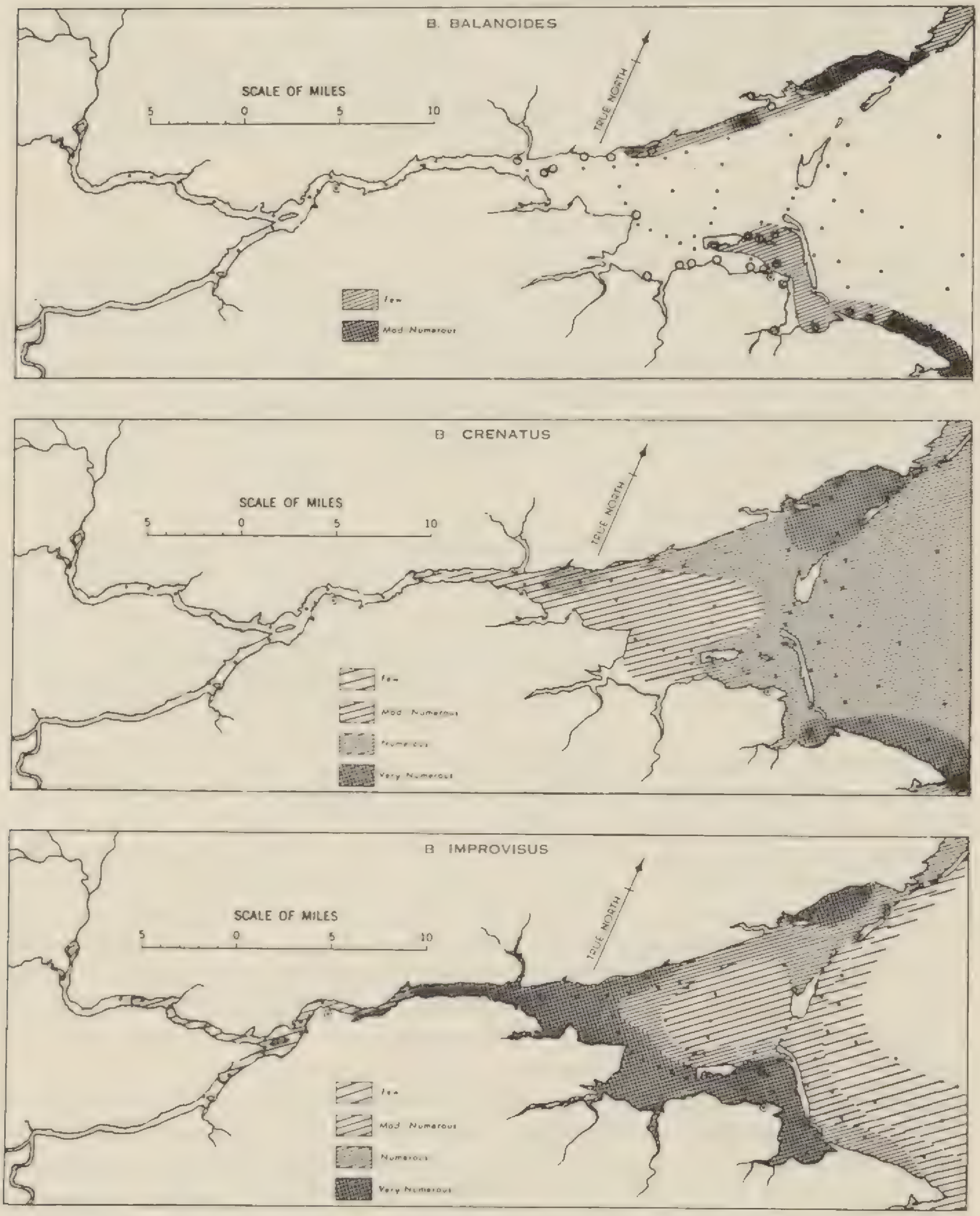


Figure 3. Distribution and relative abundance of the principal species of barnacles in the Miramichi Estuary, August, 1950.

water along the open Gulf coast at Neguac and Escuminac. In August, 1950, this species was taken abundantly along the north shore of the bay to Burnt Church and in smaller numbers to a point half a mile west of Grande Dune Island. It occurred less abundantly, however, on the south side at Baie Ste. Anne, Hardwicke, Egg Island, and the east end of Vin Island, and was absent from most of the sandy barrier islands owing to the lack of substrata suitable for attachment in the tidal zone. Relative to the observed population densities of *B. crenatus* and *B. improvisus*, the numbers of *B. balanoides* in the estuary are almost negligible, a phenomenon partly attributable to the scarcity of suitable substrata in the tidal zone throughout most of the area of occurrence. The rocky outcrops which do occur in the area are of sandstone, a substratum which is readily eroded by the action of waves and ice, and thus scarcely advantageous to the permanent attachment of large numbers of barnacles.

By way of contrast, the population of *B. balanoides* in the tidal zone in Minas Basin is extremely dense. The range of tide in this region is between 40 and 50 feet, and the width of the tidal zone is frequently more than one-quarter mile. The beaches are composed largely of outcropping shales and conglomerates of a hardness greater than that of the Miramichi sandstone. A very extensive and very dense intertidal population is thus maintained, safe from predators such as starfish, which are restricted below the low water line. Vast numbers of larvae are produced by such large populations, and settlement is correspondingly very heavy. The relatively small population of *B. balanoides* in the outer part of the Miramichi estuary may be maintained by an influx of larvae from areas to the north, as well as by those larvae which are locally spawned.

The most striking feature of the distribution is the markedly greater penetration of *B. balanoides* along the north than the south side of the Miramichi estuary. This distribution may be explained on the basis of the differential net seaward movement of salt water, under the influence of the Coriolis force, which tends to retain the surface-swimming larvae of *B. balanoides* in greater abundance on the north than the south side of the estuary.

Balanus crenatus is widely distributed in the Gulf of St. Lawrence and is particularly numerous along the rocky Escuminac coast (Figure 3). The species extends into the estuary, principally along the north side, to Sheldrake Island at the mouth of the river. A few were taken in the channel as far up river as Middle Island (bottom salinity about $15^{0}/_{00}$), and some may have occurred still farther inland. *B. crenatus* was found most commonly attached to the shells of *Spisula*, *Mya*, *Mytilus*, *Crassostrea*, other large bivalves, and other barnacles, as well as to the carapaces of lobsters and crabs. Many barnacles were noted on lobster pots which had been set out during May and June, and a few were observed on the underside of buoys.

Balanus improvisus was taken most abundantly in the main river from Middle Island to Oak Point, along the south side of the bay to Baie Ste. Anne, and also in the shallows at Neguac (Figure 3). It was moderately numerous in the main river above Middle Island to Newcastle, and a few of the current year class were taken above Bon Ami Point in the Northwest Branch, and within 2 miles of Millerton on the Southwest Branch, all in water completely fresh at low tide. Living barnacles one year of age were not found above Boishebert Island (M20), however. The spat-of-the-year were restricted to progressively deeper water with increasing distance above Newcastle.

The distribution of *B. improvisus* is closely related to the character of the bottom and the availability of surfaces suitable for attachment. The species was most frequently taken on oyster shells; its distribution, in fact, closely parallels that of the principal oyster beds in the estuary (Medcof, 1943). It was also found abundantly on *Mytilus edulis, Mya arenaria,* and *Modiolus demissus,* and on small stones and pebbles of the sandy mud bottoms. It was relatively scarce over the sand bottom of the central and outer bay and Gulf of St. Lawrence where bivalve shells and other suitable substrata were less common.

BATHYMETRICAL DISTRIBUTION

The depths occupied by each species of barnacle in each locality depend upon the responses of the cyprid-stage larvae at the time of attachment to temperature, salinity, light, substratum, and other environmental factors, and upon the survival of the adults subsequent to larval metamorphosis. Conversely, the manner in which these factors influence the depths at which the cyprids attach may be deduced from a knowledge of the bathymetrical distribution of the adults and of the level of intensity of the various factors at those depths.

The depth distribution of *Balanus balanoides, B. crenatus, B. balanus,* and *B. hameri* has been calculated from the bathymetrical data accompanying buoy material[1] taken at seventy-one stations in coastal waters of the Gulf of Maine, and supplemented by data on the maximum depths recorded for each species by Pilsbry (1916) (Figure 4). Altogether, 390 lots of barnacles, ranging in depth from the surface (on buoys) to 456 feet (on buoy chains) were examined. These lots were not, however, equally divided bathymetrically, for more than fifty per cent of the 390 lots were taken from depths of less than 15 feet and only 10 per cent from below 100 feet. Such small numbers of samples introduce sizeable deviations to the statistical treatment of the deep-water data, and the results, moreover, do not indicate the true vertical distribution and abundance of the deep-water species *B. balanus* and *B. hameri.* The significance of this inequality may be considerably reduced, however, (1) by subdividing the lots into rather obvious categories of depth so that the number of lots of barnacles in each are approximately of the same order of magnitude, and (2) by calculating the percentage occurrence, rather than the actual number, of each species in the lots of each depth range (Table I).

The plotting of the data calculated by the method above (Figure 4) also describes the relative abundance with depth between species. The depths are expressed logarithmically in order to accentuate the comparison between species and to reduce the size of the graph. Since that part of the buoy below the water line remains constantly submerged irrespective of the stage of tide, the zero depth would represent the lower low tide level along the shore.

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[1] Collections of the Woods Hole Oceanographical Institutions.

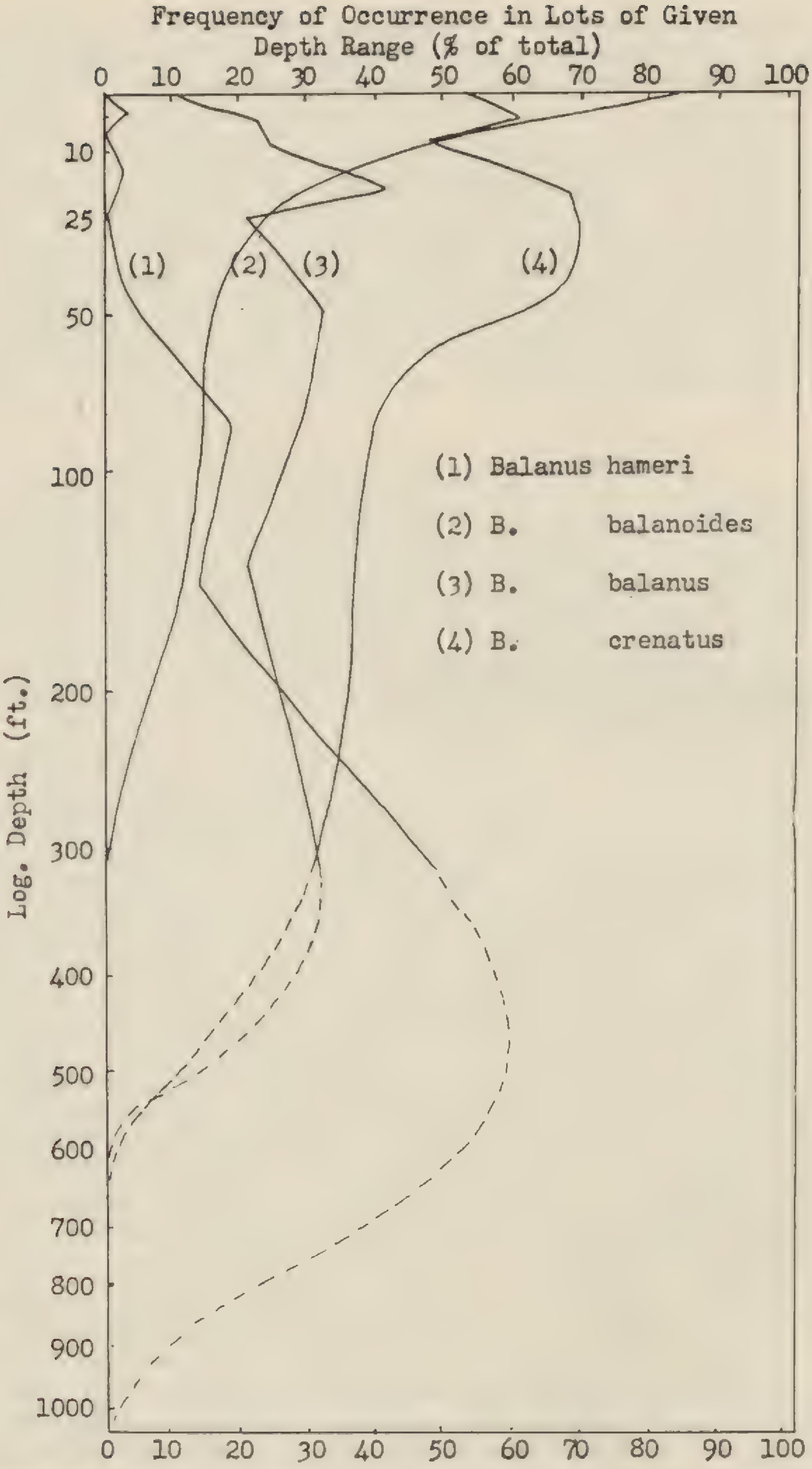

Figure 4. Depth distribution of barnacles in the Gulf of Maine (Extrapolation of curves in deep water based on maximum depths given by Pilsbry, 1916, for the species concerned).

TABLE I

The Frequency of Occurrence of Barnacles with Depth

Depth range (feet)	Total number of lots in specified depth range	Frequency of occurrence in lots of specified depth range (%)			
		B. balanoides	*B. crenatus*	*B. balanus*	*B. hameri*
0 – 1......	46	82	50	9	0
2 – 3......	53	72	55	13	2
4 – 6......	50	64	60	24	4
7 – 10......	22	46	46	23	0
11 – 15......	39	36	56	26	3
16 – 21......	30	30	67	40	3
22 – 30......	26	23	66	19	0
31 – 60......	37	14	67	32	3
61 – 100......	36	14	39	28	19
101 – 200......	30	10	37	20	13
201 – 456......	21	5	33	29	39
Total number of lots..........	390				
Percentage occurrence in lots.......		42	53	23	6

Balanus balanoides was for many years described as almost strictly intertidal in its vertical station (e.g. Sumner *et al.*, 1911). Pyefinch (1948b) noted attachment on special collectors at depths of more than five feet and drew attention to the ability of this species to live successfully under conditions of continuous immersion. On buoys in the Gulf of Maine the species was found commonly from the surface to depths of about 30 feet, below which it was scarce (Figure 4). A single find, based on some wall fragments only, was made at 204 feet, and it is highly improbable that the species occurs below 300 feet, as indicated. Along the shore this species is most abundant from the high water level of mean neap tides to the low water line (Moore, 1935c). It may occur above the upper limit in protected crevices of the splash zone or underneath pilings, etc., where exposure to light and desiccation is minimal.

Balanus crenatus is the most abundant species of acorn barnacle in the entire Canadian Atlantic region, occurring in 53 per cent of the 390 lots examined (Table I). It normally extends from the low tide line to depths of 600 feet (200 m.) (Pilsbry, 1916) but may also occur in the lower part of the tidal zone. On buoys in the Gulf of Maine it was most abundant from the surface to a depth of about 300 feet, with an "optimum" zone between 20 and 50 feet in which it was the dominant species (Figure 5). *B. crenatus* occurred less frequently than *B. balanoides* only within ten feet of the surface, and than *B. balanus* or *B. hameri* only in depths greater than 300 feet.

Balanus balanus normally occurs from the low tide line (in northern localities) to depths of about 540 feet (250 m.) but exceptionally above 108 feet in the region south of Cape Cod (Pilsbry, 1916). On buoys in the Gulf of Maine it was taken abundantly at all depths between 10 and 400 feet (Figure 4). Unlike *B. balanoides* and *B. crenatus*, however, *B. balanus* apparently does not exhibit a sharply marked "optimum" depth zone within its bathymetrical range.

Balanus hameri is the deepest ranging species of *Balanus* in the entire northwest part of the Atlantic Ocean, occurring in depths of 16 to 167 fathoms (Pilsbry, 1916). On buoys in the Gulf of Maine, *B. hameri* was taken from just below the surface to depths of more than 400 feet, but very few were taken in less than 50 feet. The "optimum" zone of attachment, however, occurred in depths greater than 100 feet (Figure 4). It was the least abundant species in the area, occurring in only 6 per cent of the entire 390 lots examined (Table I).

Balanus improvisus ranges normally from the low tide line to 125 feet (40 meters) (Pilsbry, 1916). At Beaufort, N.C., the greatest density of attachment of cyprids on collectors was between 6 and 8 feet below the low water line (McDougall, 1943). Of the many lots of *B. improvisus* presently examined from the Atlantic Coast of Canada, most were taken from the low water line to a depth of 30 feet. In the river portion of the Miramichi estuary, *B. improvisus* was found on pilings and on overhanging rocky cliffs, as much as 2½ feet above the low water line, "replacing" *B. balanoides* as the intertidal species of barnacle in brackish waters.

THE SPAWNING SEASONS OF CANADIAN ATLANTIC BARNACLES

The examination of acorn barnacles collected over broad geographical and seasonal ranges has yielded a considerable amount of data on the spawning seasons of these benthic marine invertebrates in the coastal waters of Eastern Canada. Reproduction in barnacles serves not only to ensure the survival of a population in a given area but also to provide the means, as previously noted (p. 116), by which these organisms are dispersed to new locations. The reproductive cycle in barnacles encompasses the entire period from the incipient development of eggs and sperm in the gonads to the time of attachment and metamorphosis of the cyprid-stage larvæ. The breeding season embraces that part of the reproductive cycle concerned with the deposition, fertilization, development, and hatching of the eggs in the mantle cavity of the hermaphroditic parent animal. The spawning season is the period in which the larvae are liberated from the parental brood chamber into the sea, more practically designated as the period in which the planktonic larvae may be found, and is one of the most critical phases of the life history of the organism.

The principal factor controlling the onset of spawning in many marine animals is believed to be water temperature, although other factors may work independently or in conjunction with temperature in controlling the time and duration of the spawning season. For instance, a lunar periodicity has been observed in the spawning cycle of a number of marine animals, notably the European oyster *Ostrea edulis* (Korringa, 1952), but it has not been demonstrable in many other similar forms (i.e. the American oyster *Crassostrea virginica*) and has not yet been found in the spawning of barnacles. A knowledge of the spawning season throughout the geographical range of the barnacles seems to be an important preliminary step in determining the levels of environmental factors critical to reproduction.

1. Balanus balanoides

The spawning season of *Balanus balanoides* has been fairly well established throughout its geographical range and is known to differ greatly from south to north (Hutchins, 1947). At Woods Hole near the southern limit of its distribution on the American side of the Atlantic, the larvae may be taken from mid-December to early May (Fish, 1925), and at Plymouth, England, on the European side, from December to April (Bassindale, 1936). In the Arctic, however, spawning first takes place during the summer (Madsen, 1936).

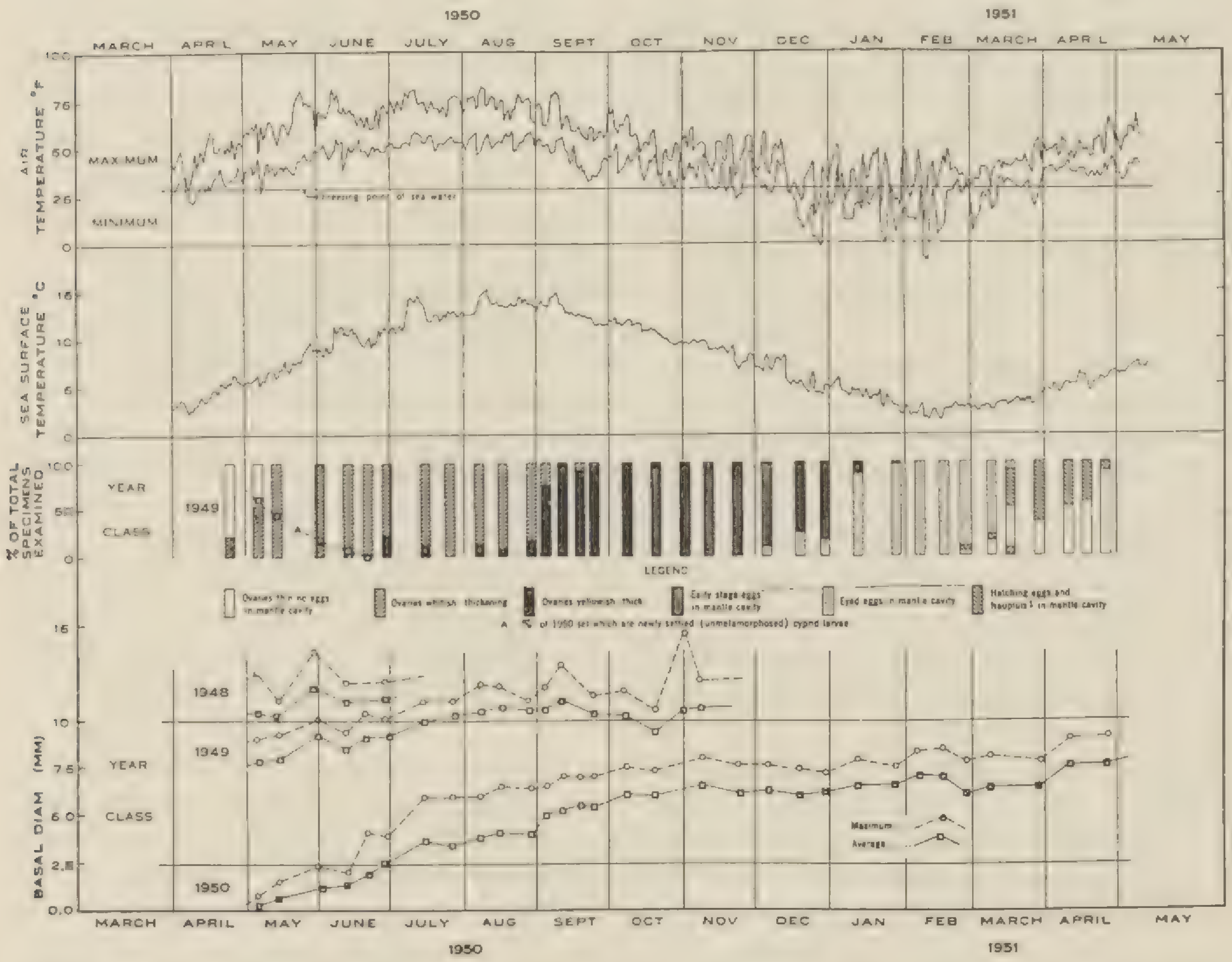

Figure 5. Seasonal changes in reproduction and growth of a population of *Balanus balanoides* from the *lower* tidal zone, St. Andrews, N.B., during 1950 and 1951 in relation to air- and sea-surface temperatures.

As predicted from the breeding condition of twenty or more specimens, selected at random from samples taken at bi-weekly intervals during the period April, 1950, to May, 1951, a single main spawning period characterizes the reproductive cycle of *B. balanoides* in the lower part of the tidal zone at St. Andrews, N.B. (Figure 5). The ovaries of the 1949-year class became opaque and whitish in colour about the end of April, thickened with incipient ova in the ovarian follicles during the summer, and became very thick and yellowish in colour in September, 1950. During October the first ova appeared in the ovigerous lamellae of the parent mantle cavity, and fertilization took place. Segmentation of the eggs progressed during November and December. The first eyed egg stage appeared in December, and subsequent development to the nauplius stage I was completed by the end of February. Spawning by the entire population was therefore probably initiated about March 1, and completed in May, 1951.

The reproductive potential apparently differs among the various year classes. None of the "ripe" specimens at any period could be definitely assigned to the first year class. The 1950 set grew mainly during the first summer and reached a basal diameter of about 7·5 mm. by March of 1951 (Figure 5), but not even the largest specimens (9·0 mm.) at that time contained eggs. In this connection Runnström (1925) found that growth in first year individuals was vegetative only and that the formation of the larvae first took place in the second year of life. At St. Andrews, following the liberation of the nauplii, the ovaries of the 1949 year class began to thicken again in May, 1951, and ripe eggs were observed in some third-year individuals of the 1948-year class taken in March of that year. Of further interest in this respect is the observation by Kuznetzov and Matveeva (1949) that the fecundity of *B. balanoides* increases with the age and size of the individual. In the St. Andrews region, therefore, the breeding of *B. balanoides* does not normally commence until the second year of life but continues at yearly intervals thereafter.

The larval stages of *Balanus balanoides* are probably found most abundantly at St. Andrews during April. Attachment of cyprids along the shore took place from mid-April to early June with a peak about May 1 (Figure 5). Most (80 to 90%) of the cyprids had attached by June 1, but a few specimens had not metamorphosed to the adult form by mid-June. The duration of planktonic existence was thus probably between five and six weeks, water temperature between 3° and 5° C.

The entire reproductive period of *B. balanoides* at St. Andrews may be correlated with prevailing air and sea surface temperatures (Figure 5). Growth and development of the ovaries took place when the water temperature was above 7·5°C. (about 45°F.). Eggs were not deposited in the ovigerous lamellae, however, until the daily air minimum had dropped to the freezing point of sea water (about −2°C.), and they completed their development in water temperatures less than 7·5°C. The nauplii were released when water temperatures were beginning to rise from the daily average winter minimum of 1·2°C. in February, and spawning was completed before temperatures had attained 7·5°C. (in May).

In 1951 the first cyprids were observed on shore rocks on April 17, and during subsequent settlement and attachment of cyprids the minimum air temperature did not fall below the freezing point. The survival of cyprids newly attached on rocks, exposed at low tide, may depend on the absence of frost. Adult barnacles, however, are able to withstand very low winter air temperatures (often below 0°F.) during exposure at low water. Controlled experiments on the resistance of barnacle cyprids to low temperature would be desirable in elucidating the full effect of frost action on the attachment stage.

The results of a series of plankton tows taken weekly during February, March, and April, 1952, in the surface waters of Halifax Harbour (J. L. Martin, collector), indicate that the spawning of shore barnacles may take place slightly earlier in this region than at St. Andrews. First and second stage nauplii appeared on February 26; third stage on March 10; fourth stage on March 21; fifth stage on March 28; and sixth stage (metanauplii) on April 4. Although circumstances prevented sampling of the plankton after that date, it is probable that cyprids first settled on the shore about April 10. The total duration of planktonic existence was therefore between five and six weeks, and, as ice was observed in the harbour from time to time, surface temperatures were probably less than 3°C. during this period.

The spawning season of *B. balanoides* in areas of the Gulf of Maine other than St. Andrews may be interpreted from the breeding condition of buoy specimens (W.H.O.I. collections) and from the results of plankton tows taken by previous investigators (e.g. Fish and Johnson, 1937). Buoy material is accompanied by accurate chronological data as to the earliest and latest possible dates of attachment. As buoys in the Gulf of Maine are usually changed at least once a year, nearly all the specimens of barnacles examined were less than one year old. None contained eggs or larvae, even when taken in April and May. It is probable, therefore, that the first-year individuals continuously immersed on buoys do not spawn, as in barnacle populations in the tidal zone at St. Andrews.

Confirmation of the spawning season of *B. balanoides* in the Gulf of Maine, derived by the analysis above, was also provided by observations on the size of buoy specimens. Growth rates for *B. balanoides* at various temperatures have been determined by Runnström (1925) and Moore (1934a), but these rates are used with reservation in the light of the observation of Pyefinch (1948b) that the growth rate of specimens continuously immersed is typically greater than that of barnacles intermittently exposed by the tides. In June, two size classes were present: large specimens that had attached the previous year, and small, newly settled individuals of the current year class. In Cape Cod Bay the size of the new set was 3 to 4 mm. in basal diameter, indicating that attachment had commenced about two months previously (about the end of March) and continued on into May. In Casco Bay to the north, very small specimens (but no cyprids) were noted on buoys lifted during the period April to July, and at Eastport, Maine, (near St. Andrews) on buoys changed in September.

The planktonic larvae of *B. balanoides* were also taken throughout the Gulf of Maine, most abundantly in April and May, although small numbers persisted in surface tows of July, August, and September (Fish and Johnson, 1937). The further significance of these observations is discussed in a later section (p. 147).

The spawning season of *B. balanoides* in the Miramichi estuary was predicted from the breeding condition of adult specimens by observations on the size of newly attached specimens, and by comparison of hydrographical conditions with those of St. Andrews, Halifax, and other areas where the spawning period of this species was more completely known (Figure 6). Plankton tows were unfortunately not commenced until most of the larvae had attached. Of eighteen specimens from the Escuminac breakwater, May 4, 1952, eight contained eggs in very late stages of development (eyed egg to nauplius I), and the remainder were empty, apparently spawned out. Of eleven specimens examined on May 18, however, only three still contained eggs. A recent set of very small (1 to 2 mm.) specimens, at most only two to three weeks old, was observed on a mooring stone in shallow water at Gregan's shore on June 1, 1951. Specimens observed on rocks at Hardwicke wharf, June 9, were slightly larger than this but not more than one month old. All these observations indicate that spawning probably first took place early in April and finished late in May. The spawning season of *B. balanoides* in the Miramichi estuary thus commences later and finishes earlier than at St. Andrews.

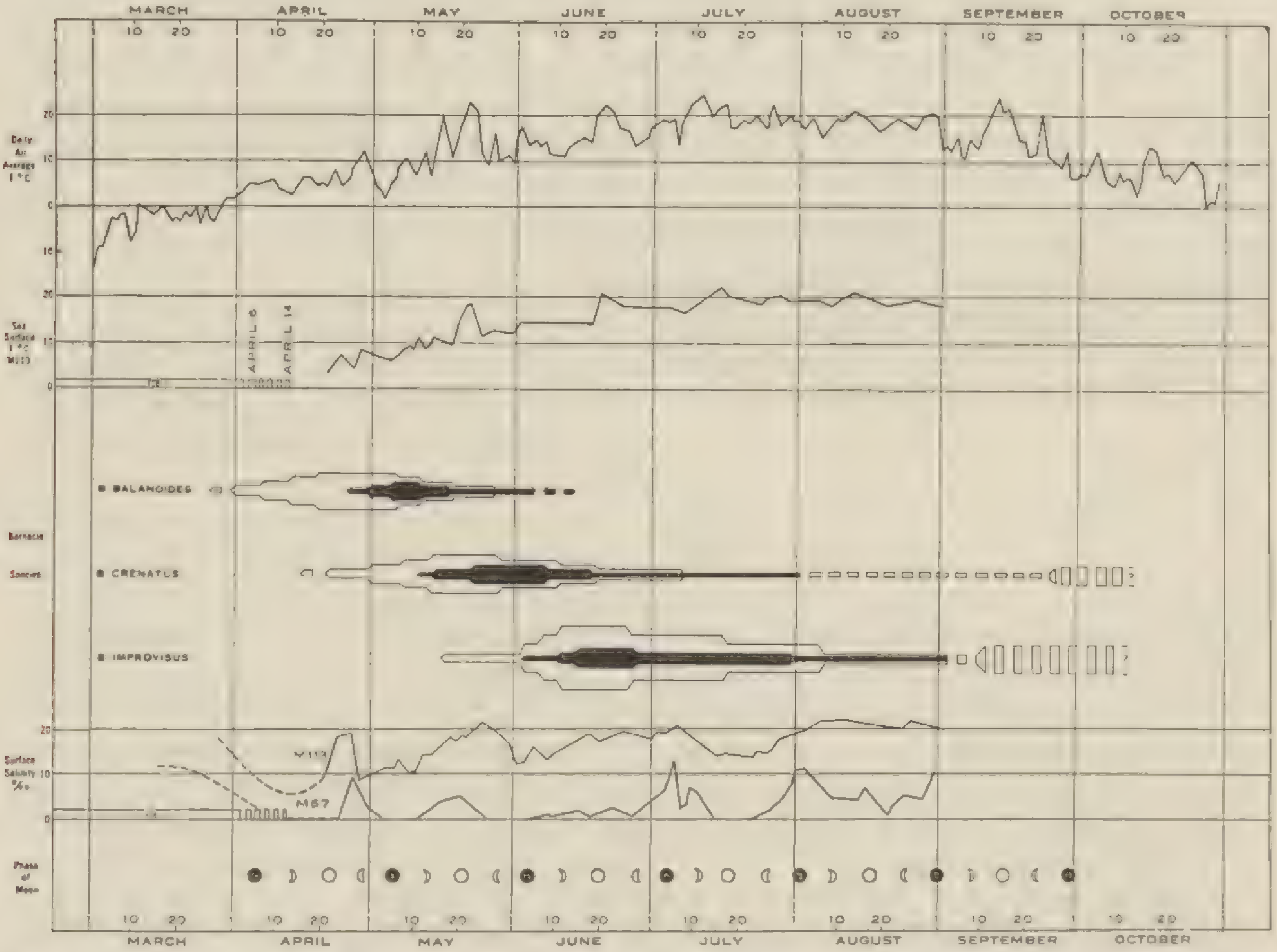

Figure 6. Seasonal occurrence and changing abundance, relative to temperature and salinity, of the principal species of barnacle larvae in the Miramichi Estuary, 1951.

▭ Relative abundance of all larval stages combined.

▲ Relative abundance of cyprid stages.

The probable spawning period of *B. balanoides*, predicted above, receives further support from an analysis of air and water temperatures in the Miramichi area during April and May (Figure 6). Spawning must first take place in April in order to account for the presence of newly attached specimens in mid-May. Ice that had covered the bay from shore to shore in March (Table I) first left the north shore about April 1, the river at Chatham on April 6, and the south shore by April 14, 1951. The spawning of barnacles in the tidal zone, while ice was still frozen fast to the beach, was improbable and therefore did not take place before April 1 when the break-up began. Surface temperatures rose rapidly from then on and reached peaks of 8° or 9° C. by May 1, although temperatures at Escuminac and other localities outside in the Gulf probably did not reach this level until well on in May (Lauzier *et al*, 1951). Thus the main spawning period inside the estuary probably commenced shortly after April 1 and reached a peak toward the end of that month, whereas spawning in Gulf areas was probably later.

The duration of larval life at St. Andrews and Halifax is probably about five or six weeks, surface temperatures 2° to 5° C., whereas that in the Miramichi estuary during April and early May is probably only four to five weeks, surface temperature 0° to 10°C. Attachment may have first taken place about the end of April (Figure 6), reached a peak during the second week of May, and declined rapidly from then on. Surface temperatures late in May were well above 10° C. and much above the maximum temperatures in which larvae of *B. balanoides* were taken in the Gulf of Maine, even during July and August, by Fish and Johnson (1937). As discussed in a later section (p. 148) water temperatures greater than 15°C. may be lethal to the larvae of *B. balanoides*.

The contrast between the spawning season of *B. balanoides* in the Miramichi estuary and that of St. Andrews is particularly striking when it is remembered that only two degrees of latitude separate these two localities. Air temperatures in April are higher at St. Andrews than at the Miramichi estuary, owing to the proximity of the former locality to the relatively warm air masses over the open Atlantic Ocean. The rise in temperature during late April and May is more rapid in the Miramichi region than at St. Andrews, however, as daily air averages reached 20°C. by mid-May (15° C. at St. Andrews) and sea surface temperatures attained 14°C. (9°C. at St. Andrews) by June 1. At St. Andrews, therefore, the relatively warm winter air and sea surface temperatures, gradually rising in April and May to a low summer maximum, are paralleled by a relatively early spawning, lengthy period of larval swarming, and late completion of attachment. In the Miramichi, on the other hand, the sea is ice-bound until mid-April, but both air and water temperatures rise rapidly during late April and May to relatively high values in June. The entire period of larval development in *B. balanoides* is correspondingly abbreviated, with late spawning, short period of larval abundance, and early termination of planktonic existence.

2. **Balanus crenatus**

The spawning period of *B. crenatus* varies somewhat throughout its geographical range, occurring mainly during late spring and early summer in southern localities but in mid-summer in the Arctic. For example, records of the nauplii of *B. crenatus* have been obtained in Boston Harbour, May 3, 1952, by the writer; off Coney Island on June 12 by Fish (1925); and many from the Cape Cod region and Long Island Sound from April to early July by Deevey (1948, 1952). Also, spawning is much earlier at localities of equivalent latitude on the European than on the American side of the Atlantic. It must be remembered, however, that the warm North Atlantic Drift moves northward along the European coast, whereas the cold Labrador Current moves southward along the American coast.

In the Bay of Fundy and Minas Basin, nauplii and cyprids of *B. crenatus* taken in 7 m. plankton hauls, July 19, 1951 (A. G. Huntsman coll.), have been examined by the writer. New sets of *B. crenatus* were observed along the shore at Hampton and Noel at the head of the Bay of Fundy on June 23 and 25, 1950, respectively. Adults containing late-state eggs in the mantle cavity, and newly attached specimens were observed on the undersurfaces of buoys at the entrance to the Bay of Fundy on June 26, 1950.

In the British Isles, near the southern limit of its range in Europe and much farther north (about 10 degrees of latitude) than the Nova Scotia localities above, the initial spawning of *B. crenatus* takes place in mid-February and continues until August (Pyefinch, 1948b). Moreover, some which attach early in April contain developing ova by July 1 and produce larvae which attach before the end of the summer. Attachment of both larval broods takes place from March until October.

The spawning period of *B. crenatus* in the Gulf of Maine was also predicted from the breeding condition of specimens from buoys. The presence of the current year class and a few year-old adults containing late-stage eggs in the mantle cavity in material from the Cape Cod (southern) region, June 1, indicates that spawning probably commenced late in April. In the Casco Bay area to the north a new set occurred first in June, indicating spawning early in May. By early August the adults were spawned out, but up to 50 per cent of the new set contained eggs in all stages of development. There can be no doubt that these spawners were of the current year class, for the buoys from which they were taken were first set out in February of the same year. At Eastport, Maine, near St. Andrews, however, the new set was not observed until late June. The adults contained eggs in all stages of development at this time, but some contained no eggs or larvae and appeared to have spawned out. By late August some of the current year class contained eggs, and spawning probably took place again in September and October. Attachment of the second generation was probably complete by November in this region.

To summarize, *Balanus crenatus* produces two generations each year in the Gulf of Maine, as it does in the British Isles. Adults of the previous year class spawn mainly during May and June, and the attachment of cyprids is heaviest in June and July. The early set grows to sexual maturity in two or three months and spawns first in August of the same year. Second-generation larvae attach mainly in September and October. The latest spawned larvae of the first generation overlap the earliest spawned larvae of the second generation, however, owing most probably to the late spawning of populations of barnacles in deepest and coldest waters. For example, the larvae of *B. crenatus* identified in surface hauls from the Gulf of Maine in late August and September by Fish and Johnson (1937) were probably second-generation larvae, for the most part. Spawning commences about two or three weeks earlier in the Cape Cod Bay (southern) portion of the Gulf than in the Bay of Fundy to the north.

Off southern Newfoundland and Nova Scotia the spawning season may occur still later in the year than in the Gulf of Maine. The fact that adult barnacles taken in 36 fathoms off Artimon Bank, April 27, 1952 ("Investigator II", through H. J. Squires) contained eggs only in early stages of development indicates that spawning may not have taken place before June 1 of that year. In the Arctic the breeding season is probably still later. In several lots of specimens dredged as late as August 27 in 13 to 60 fathoms at stations on the outer coast of Labrador ("Blue Dolphin" Expedition), eyed eggs were still to be found in many specimens a year or more of age. The first set of the current year class was noted in material collected on July 22, but by the end of August this set had not grown very large (3 to 6 mm.). None were observed with eggs, indicating that only one brood a year may be normal in Arctic areas.

The spawning period of *B. crenatus* in the southern part of the Gulf of St. Lawrence was estimated from the ovigerous condition of adult barnacles and from the seasonal occurrence and size of the new set collected mainly in the inshore shallows. During June, adult barnacles collected along the shore contained eggs, but those taken in July and August were empty. Lobster pots brought ashore on July 1 at many localities in this region were thickly coated with small *B. crenatus.* By July 12 shore specimens at Charlottetown and Souris, P.E.I., had reached a basal diameter of 5 mm. It is probable, therefore, that spawning takes place mainly during May and June in this region.

The spawning season in the Miramichi estuary was estimated mainly from the occurrence of larval stages in plankton tows taken during June, 1951 (Figure 6), but additional evidence was obtained from the breeding condition of adult barnacles taken in dredge hauls and from the size of specimens newly attached to buoys. The average number of larvae in twenty plankton hauls made in Miramichi Bay during the first and second weeks of June was three per 125-liter sample, but on June 17 it had decreased to 1·5 per haul, and on June 23 and 24 it was only 0·7 per haul. Thereafter only one or two larvae were taken in the entire twenty to thirty hauls of each cruise, and none were taken later than July 8. As the duration of larval development at prevailing temperatures (13 to 15°C.) is about three weeks (Pyefinch, 1948b), the presence of cyprids in the water and of a very recent set of spat on a sinkstone off Gregan's shore, June 1 to June 3, indicates that spawning commenced no later and probably earlier than the second week of May. Of eight specimens taken June 17 from a buoy set out May 1 at Gardiner Point, two specimens measured 5·4 mm. and the remainder about 4·2 mm. in basal diameter. On the basis of the known growth rate in this species at 15°C. (Pyefinch, 1948b), the largest specimens were probably five weeks beyond metamorphosis. The earliest cyprids could have attached no later than the second week of May, and spawning therefore commenced no later than mid-April.

The initiation of spawning in *B. crenatus* in the Miramichi is about two weeks later than in *B. balanoides* (Figure 6). In the British Isles where sea surface temperatures seldom fall much below 4°C., however, *B. crenatus* begins spawning in mid-February, "rather earlier" than in *B. balanoides* (Pyefinch, 1948b). It must be remembered, however, that *B. balanoides* in Britain is exposed to freezing air temperatures at low tide in February, whereas *B. crenatus* living below the tide lines, is not so affected.

In the Miramichi estuary, adults of both present and previous generations taken in August and early September contained eggs. Spawning probably commenced again in September and continued into October (Figure 6). A bimodal breeding season appears to be characteristic of *B. crenatus* in the Miramichi estuary and perhaps also in the shallows of the entire southwest part of the Gulf of St. Lawrence, from Chaleur Bay to Cape Breton Island.

3. Balanus improvisus

The spawning season of *B. improvisus*, like that of *B. balanoides* and *B. crenatus*, varies greatly throughout the geographical range of the species. In the Zuider Zee, Europe, the larvae of *B. improvisus* may be taken from May until November in water temperatures continuously higher than 10°C. (van Breemen, 1933). The adults spawn mainly during May and early June, and the cyprids attach by the end of June. The newly metamorphosed barnacles grow rapidly, reach maturity in August, and spawn in September. In the Oslo fiord the larvae do not appear until late May and early June, after the surface temperature has reached 10°C. (Broch, 1924).

On the American Atlantic Coast the spawning of *B. improvisus* is also earliest in the south and latest in the north. At Miami, Florida, the larvae are first abundant in March and again from October to December (Weiss, 1948); at Beaufort, N.C., in June and July (Visscher, 1928); and in the Gulf of Maine still later. In Minas Basin, Bay of Fundy, specimens from the low water line, June 23, 1950, contained eggs in the 'eyed' stage of development, indicating that spawning commenced about July 1. Moreover, nauplii and cyprids were identified in plankton tows taken in this area on July 18, 1951 (A. G. Huntsman coll.). In the Saint John estuary, N.B., H. A. Rogers (unpublished MS.) found the larvae (presumably of *B. improvisus*) numerous during the latter part of August and early September. At Liverpool on the outer coast of Nova Scotia, buoy specimens were in spawning condition on July 6, although most individuals contained incompletely developed eggs.

The spawning season of *B. improvisus* commences rather earlier in the Gulf of St. Lawrence (Miramichi Bay) than in the Bay of Fundy (Figure 6) probably owing to the more rapid rise of sea surface temperatures accompanying vernal heating in the former region. The seasonal limits and periods of abundance of larvae were estimated almost entirely from the results of some 500 plankton tows taken in the estuary, May 31 to September 3, 1951, but additional evidence was obtained from the breeding condition of the adults and from the attachment and growth of the new set on buoys during this period.

During the first week of June the tows contained mostly nauplius, stages I and II, some nauplius III, and nauplius IV, a few nauplius V and VI, and two cyprids. The duration of larval life at prevailing water temperatures was probably about three weeks (Bousfield, 1954, in press), indicating that spawning was initiated about the middle of May. Such early spawning is in accord with the surface temperatures which had attained 10°C. by that time, and also with the prolonged heat wave which occurred during the third week of May (Figure 6). By June 9 and 10 stage IV had become numerous, and stage V was not uncommon, and on June 17 both nauplius V and VI were abundant and the cyprids appeared in numbers for the first time. The period of development of the first main larval brood lasted from the end of May until the middle of June, and during this three-week period the surface temperature averaged between 14 and 16°C. During July and August when surface temperatures were close to 20°C. the duration of larval life in *B. improvisus* was probably about two weeks.

Spawning continued throughout the summer although early stage nauplii became much less numerous during July and August, and attachment of cyprids on buoys was correspondingly less also. The tows of early September contained more of nauplius stage II than did those of the previous three weeks, and buoy specimens that had attached in June contained ripe eggs by the end of August. A second main spawning thus very probably took place in September and October, although field observations were not made to substantiate this prediction. A bimodal spawning season in *B. improvisus* in the Miramichi estuary is in accord with that already noted in Holland by van Breeman (1933).

The present limited observations on the changing abundance of the larval stages during the breeding period in the Miramichi estuary may be examined for evidence that lunar periodicity characterizes the spawning of *B. improvisus*. Precocious spawning commenced about May 15; the initial spawning of importance occurred about May 31, and peak numbers of early stage larvae were present on June 17, periods all following closely upon the quarter moon and neap tides. It is possible that the coincidence of these observations is spurious, however. Plankton tows were not commenced sufficiently early in the season, nor taken frequently enough to 'follow' a spawning burst, had one occurred. Also, the influence of salinity on spawning may be masked by such a correlation. Salinities were highest following new and full moons (spring tides), except during heavy river discharge, and were lowest following first and third quarter moons (neap tides) (Figure 6). During May and June the river discharge is at a very high level, and the proportion of warm fresh river-water in relation to the amount of cold salt water in the estuary is probably higher than average, particularly during the neaps. The salinities and temperatures actually measured at both river and bay stations during this period were not completely in agreement with this prediction (Figure 6), and more detailed measurements are necessary before conclusions may be drawn as to the possibility of a lunar- or salinity-controlled cycle of spawning in *B. improvisus*.

4. **Balanus balanus** and **B. hameri**

The spawning seasons of the deep-water species, *Balanus balanus* and *Balanus hameri*, were little known prior to the present investigation. Several factors have contributed to the meagreness of published information which jointly provide a useful index to the ecological requirements of the larvae. The adults, found mainly in deep water throughout their range, did not attract the attention of early ecologists, as species suitable for ecological studies were more readily available along the shore and in the shallows. The deep-water species are infrequently taken as fouling organisms on ships, pilings, etc., and their economic importance is so slight as to warrant little consideration from the practical aspect of biological research. Also, breeding in these species is now known to take place during March and April, months in which marine field work in the North-Temperate zone is not popular, and the larvae are therefore unlikely to be taken at all. Furthermore, from the vertical distribution of the adults on buoys (Figure 4), it appears that the larvae are benthophilic and do not normally occur at the surface where most plankton samples have been taken in previous investigations. Moreover, being in deep water, adults are usually located far from shore and the larvae are not abundant inshore where plankton tows are more easily taken, even in winter. Attempts to rear the larvae in the laboratory and associate them with the adult have not yet been successful. The difficulties normally experienced in lab-rearing barnacle larvae (Bassindale, 1936) are made even greater by the difficulty of duplication of the natural ecological requirements of the larvae. The paucity of adequate published descriptions and figures of even the most common species of barnacle larvae has been deplored by Deevey (1948), and these have only recently been published (i.e. Pyefinch, 1948a). Also the larvae of *B. balanoides* and *B. crenatus* occur in superabundance during the breeding season of the deep-water species, and it is very probable that trace numbers of larvae of these deep-water species occurred but were not identified in previous quantitative and ecological analyses of the plankton of coastal waters (e.g. Fish (1925), Fish and Johnson (1937), Thorson (1946).

The spawning season of *B. balanus* in the Gulf of Maine and Bay of Fundy apparently takes place mainly in the spring. Of three adult specimens dredged in Passamaquoddy Bay (off St. Andrews), April, 1950, one contained late-stage eggs and nauplius stage I. In the Cape Cod area to the south, small specimens (1 to 2 mm.) were numerous on buoys lifted in June, and by August some had attained a basal diameter of 10 mm., all indicating that spawning occurred in April and attachment in May. Buoy specimens from Casco Bay to the north indicated a similar spawning period. North to the St. Andrews region again (Eastport, Maine), buoy specimens collected in August ranged in size from very small (1 to 2 mm.), and probably newly attached, to medium sized (10 to 12 mm.) and probably three or four months old. The continued presence of small individuals even in buoy samples of late October indicates that some attachment may have taken place as late as September. The fact that none of the year-old buoy specimens were found in ovigerous conditions indicates that spawning may not occur in this species (as in *B. balanoides*) until the second year of life.

To summarize, the spawning of *B. balanus* in the Gulf of Maine probably takes place mainly in late March and April but diminishes from then until August. The earliest spawning is probably attributable to the shallowest individuals and the latest spawning to the deepest specimens. Further evidence, particularly of the larvae in the plankton, is required to establish more precisely the limits of the spawning season of this species in Canadian Atlantic coastal waters.

References to the spawning season of *B. hameri* in American Atlantic waters are also lacking, but a few are available for European localities. Larvae, presumably of this species, were found swarming in Norwegian fiords on March 24, 1899 (Hoek, 1909). In the British Isles (Isle of Man) the shedding of genital products into the mantle cavity occurs some time between December and March (Moore, 1935a). Reproduction takes place only once a year and first-year individuals do not spawn, a type of reproductive cycle previously observed in *B. balanoides* and probably also in *B. balanus*.

In the Gulf of Maine and Bay of Fundy the spawning season of *B. hameri* apparently takes place in the spring. Of more than twenty adult specimens of *Pecten grandis*, dredged from 40 fathoms on the 'Hour Ground' off Digby, N.S., April 21, 1951 (G. L. Hudson coll.), at least ten contained late-stage eggs and nauplius stages I and II. Specimens obtained in May and June of that year contained no eggs, and the ovaries were thin. A set of the current year class observed on buoy chains removed from Penobscot Bay in October had reached a basal diameter of 18 mm. On the basis of the growth rate calculated for this species (Moore, 1935a), the largest were more than three months and the smallest about one month of age.

To summarize, the liberation of the nauplii takes place mainly in late March, April, and early May, and attachment of cyprids is heaviest in May and early June. The persistence of attachment until September may be attributable to late spawning in populations of *B. hameri* in very deep, cold water.

The present evidence suggests also that some variation occurs in the spawning season throughout the range of *B. hameri* in Canadian Atlantic coastal waters. The outer walls of two large specimens taken in Fortune Bay, south coast of Newfoundland, April 21, 1952, were coated with about 300 cyprids, all in the process of metamorphosis to the adult stage. It is possible that these larvae developed to the cyprid stage within the mantle cavity of the adult and attached immediately on liberation. At Rigolet, Hamilton Inlet, the northernmost area of occurrence of *B. hameri* presently known in Eastern Canada, a new set measuring 5 mm. in basal diameter was dredged in 10 fathoms, July 21, 1921 (E. M. Kindle coll.), indicating that attachment takes place there late in June.

DISCUSSION

The results of the present study provide additional records of the local distribution of some species of barnacles and considerably extend the known ranges of others on the Atlantic Coast of Canada. Confirmed are the known distributions of *Balanus balanus*, from the high Arctic south to Cape Cod but absent from the Grand Banks of Newfoundland, and of *B. crenatus* and *B. balanoides*, widespread in the entire region from the low Arctic to New Jersey. *Balanus eburneus*, *B. amphitrite niveus*, and *Chthamalus fragilis*, all southern species which range northward into the boreal region at Cape Cod, were not found in the shallows of the warm (in summer) southwest part of the Gulf of St. Lawrence. New is the finding of *B. hameri* on the Grand Banks and north to Hamilton Inlet, Labrador, and also of the finding of *B. improvisus* in many estuaries of the Bay of Fundy and outer coast of Nova Scotia, and widespread in the entire southwestern part of the Gulf of St. Lawrence, from Nova Scotia to the head of Chaleur Bay. The goose barnacles *Lepas anatifera* and *L. hilli* are recorded from buoys on the southwest coast of Nova Scotia.

Previous descriptions of the bathymetrical distribution of *Balanus crenatus*, *B. improvisus*, and *B. balanus* are amply confirmed by the present data. The finding of *B. balanoides* on buoys in the Gulf of Maine in large numbers to a depth of 30 feet and in small numbers to a depth of 204 feet confirms the findings of Stephensen (1933) and others that this species occurs in the littoral zone to depths of more than 100 feet but is at variance with the views of many others (i.e. Sumner *et al.*, 1911) that it is restricted almost entirely to the tidal zone. Noteworthy also is the occurrence of *B. hameri*, normally abundant only in deep water, within 50 feet of the surface, but its rarity within 10 feet of the surface does not support the bathymetrical classification of Kindle and Whittaker (1918) that *B. hameri* occurs in the tidal zone.

The manner in which the environmental factors control the distribution of barnacles may be more closely examined by studying the distribution of each species in suitable local areas such as the Miramichi estuary, New Brunswick. It has been noted already how some species are restricted mainly to the deep offshore areas, others to the coast, and still others to estuaries and inshore shallows. The ultimate distribution of barnacles on the bottom depends chiefly upon the dispersal of the planktonic larvae from their place of origin, the presence of suitable substrata at the time of attachment, and the survival of the adults subsequent to larval attachment and metamorphosis.

The inclusion or exclusion of barnacles from estuaries has been described in a contemporary paper (Bousfield, 1954, in press). A characteristic feature of coastal plain estuaries is the meeting and mixing of fresh water from the land with salt water from the open sea. Where the influx of river water is considerable, there exists, superimposed on the normal ebb and flow of the tides, a residual or net seaward movement of brackish water at the surface and a residual counter current of salt water along the bottom to replace that being mixed with the fresh water. Planktonic animals drifting near the bottom are thus carried into such estuaries, and those near the surface out of them.

Now the "optimum" depth at which the larvae of barnacles (and other benthic animals) swim depends chiefly upon the stage of larval development. For instance, the early stage larvae of *B. improvisus* are mostly near the surface, whereas the late stages are much deeper down, often near the bottom and both the early and the late stage larvae of *B. crenatus* are deep-swimming, whereas all larval stages of *B. balanoides* swim mainly near the surface. Thus the deep-swimming cyprids of *B. improvisus* and *B. crenatus* tend to be carried into, and the surface-swimming cyprids of *B. balanoides* out of, coastal plain estuaries such as the Miramichi. This difference in direction of larval transport chiefly accounts for the differences in distribution of the adults noted in Figure 3.

The wastage of planktonic larvae in a seaward direction is proportional to the duration of the free-swimming period (Thorson, 1950). Larvae of intertidal species such as *B. balanoides* may ultimately reach the shore during sustained onshore winds, exceptionally high tides, and at night when more of the larvae are deeper down, and thus maintain small populations of adults at the mouths of estuaries.

A mechanism for the retention of plankton similar to that outlined above may similarly apply to the maintenance of populations of *B. hameri* in Penobscot Bay and Hamilton Inlet, and of *B. balanus* in the St. Lawrence estuary and at the mouths of other deep estuaries of the Canadian Atlantic region. The bathymetrical distribution of the adults on buoys (Figure 4) supports earlier views (i.e. Broch, 1924) that the larvae of these species are negatively phototaxic and remain deep down during their planktonic existence, probably just above the bottom. Data on the hydrography of Hamilton Inlet given by Nutt (1951) indicate the existence of a deep net landward movement of salt water (temperature about 2°C.) which replaces that being mixed with the much warmer seaward flowing river water at the surface. Here then appears to exist an ideal mechanism for the concentration of the benthophilic larvae of *B. hameri* and the maintenance of a large endemic population of adults of this deep-water species within the Hamilton Inlet, although none are known to occur outside in the Labrador Sea.

The landward limit of survival of barnacles in estuaries is influenced chiefly by low salinities, a phenomenon long maintained for many marine organisms in many estuaries, but particularly well illustrated by *B. balanoides*, *B. crenatus*, and *B. improvisus* in the Miramichi estuary (Bousfield, 1954, in press). *B. balanoides* and *B. crenatus* are most abundant, and thrive most successfully, in fully marine waters, although both species tolerate salinities as low as 15 to 18‰ or perhaps lower, and *B. balanoides*, by remaining tightly closed, may withstand short periods of immersion in tidal pools of completely fresh water. Ekman (1953) designates *B. improvisus* as a marine euryhaline species. However, the fact that the local centres of distribution and abundance of this species occur *inside* estuaries (i.e. the Miramichi, salinity 10 to 25‰) and not along the outer coast even of the warm Gulf of St. Lawrence region indicates that *B. improvisus* carries out its life cycle more successfully in diluted than fully marine waters and may therefore be more appropriately described as a brackish-water species. The deep-water barnacles *Balanus balanus* and *B. hameri* are essentially marine both in distribution and in metabolic requirements. *B. balanus* occurs off the mouth of the Miramichi estuary (salinity 25 to 27‰), but no living specimens were taken inside the bay during the present survey. The species also penetrates the Baltic in the company of *B. crenatus*, as far as Bornholm (Ekman, 1953) and probably tolerates salinities of 15‰ or even less. *B. hameri*, on the other hand, seldom occurs in salinities much less than 30‰ and is stenohaline.

Many types of substrata suitable for the attachment of larval barnacles are available throughout the region considered. Attachment is particularly favoured on rocky or stony coasts, and in muddy or sandy areas by the presence of bivalve shells, more especially those of *Crassostrea*, *Mytilus*, *Mya*, and *Spisula*, in shallow water; and *Pecten*, *Modiolus*, and the gastropods *Buccinum*, *Sipho*, *Neptunea*, and *Polinices*, in deeper water. *B. crenatus* very often occurs on the carapace of *Hyas*, *Cancer*, *Homarus*, and other large crustaceans. As noted previously, the attachment of barnacles of successive year classes upon one another is common and provides a useful guide to the ageing of specimens which spawn only once a year.

The abrasive action of waves during the summer and ice during the winter are important factors restricting *B. balanoides* from the tidal zone of sandy, muddy, or soft sandstone coasts. For this reason, sessile marine animals and attached algae are scarce in the tidal zone of the sandy coasts of Prince Edward Island and other similar areas of the southwestern Gulf of St. Lawrence (Stephenson, 1953, in press). The severity of ice action in winter in the Gulf is indicated by the extent of the ice formation in the Miramichi estuary. The greater degree of icing along the south than the north side of this estuary probably contributes in fair measure to the correspondingly smaller numbers of *B. balanoides* on suitable substrata along the south than the north side of the region.

The ability of *B. balanoides* to withstand prolonged freezing air temperatures during winter and very high temperatures and desiccation in summer enables this species to colonize the tidal zone of the entire Canadian Atlantic region. *Balanus improvisus* may colonize the lower third of the tidal zone of brackish waters, more especially on the north side of rocks, stakes, or under wharf pilings and other places which are not exposed to direct sunlight, but the entire population in the tidal zone is killed by freezing air temperatures in winter. The scarcity of the newly settled spat of *Balanus crenatus* in the tidal zone, except very near the low water line, indicates that this species is unable to withstand desiccation. The fact that *B. balanus* is not found in shallow water except in Arctic areas indicates that the adults are unable to tolerate high summer water temperatures. *B. hameri* is probably still more narrowly stenothermal species.

The finding of *B. balanoides* abundantly on buoys and their mooring chains to depths of 30 feet is in direct contrast with the scarcity of the species along the shore below the tide lines. Huntsman (1918) found evidence that the lower limit of abundance of *B. balanoides* in the tidal zone in the Bay of Fundy is influenced largely by the predation of starfish (*Asterias* spp.). The present results indicate that competition with *B. crenatus* may also restrict the size of the population of *B. balanoides* below the tide lines. The presence of larvae of *B. balanoides* in the water (near St. Andrews) during July and August (Fish and Johnson, 1937) and long after the barnacles of the tidal zone have spawned out (Figure 6) is indicative of the fact that some *B. balanoides*, however, do complete their life cycle in shore areas that are continuously submerged. Barnacles attached to buoys, however, are admirably protected from large starfish and other benthic marine predators in much the same manner as the eggs and young of birds in artificial bird houses are protected from the common house cat and other terrestrial predators. Large starfish on the bottom must first chance upon the mooring block and then climb up the long iron mooring chain, impeded by kelps, hydroids, and other fouling organisms, in order to reach the buoy floating at the surface. The young of *B. balanoides* attach early in the year, grow very rapidly, and soon reach a size well beyond the attacking power of young starfish which quit their planktonic existence and settle upon the buoy at a later period. It is conceivable, therefore, that barnacle fouling (and also that by mussels and other bivalves) might be greatly reduced by artificially accelerating the natural colonization of buoys by starfish.

On the basis of the material examined during the present investigation the maximum age attained by each species is as follows:

	years
B. balanoides	6
B. crenatus	4
B. improvisus	2
B. balanus	7
B. hameri	8

These results are in accord with those of Runnström (1925), van Breemen (1933), Moore (1934, 1935, 1936), Stephensen (1933), and others, that *B. balanoides, B. crenatus, B. balanus*, and *B. hameri* normally live more than two years, but that *B. improvisus* usually dies during its second year.

The maximum size attained may be arranged in series according to the bathymetrical distribution of the species. *B. balanoides* and *B. improvisus*, living in the tidal zone and inshore shallows, are smallest; *B. crenatus* and *B. balanus*, at intermediate depths, are intermediate in size; whereas *B. hameri*, ranging deepest of all, is by far the largest species. Interestingly enough, the southern *Chthamalus fragilis*, living above *B. balanoides* near the high water line, is one of the smallest existing species of barnacles. Small body size is clearly advantageous to species of the tidal zone and inshore shallows as it facilitates the colonization of small crevices and niches among the rocks, shells, and other substrata removed from the direct abrasive action of waves and ice, and from the excessive heating and drying action of the sun. Large body size, on the other hand, probably affords to species living below the tide lines a measure of protection against many types of starfish and other benthic marine predators. The body size of each species is also proportional to the available feeding time in each bathymetrical subdivision of the sea bottom; thus, in deep, relatively motionless water, feeding may be almost continuous, whereas in the shallows the time spent feeding is less, owing to the violent water movement and silting caused by wind and tidal currents, and in the tidal zone it is least because of the regularly intermittent exposure of the sea bottom to the air.

The present results also support the findings of Runnström (1925) and others that *B. balanoides* grows vegetatively the first year but does not spawn until the second; of Pyefinch (1948b) that *B. crenatus* may reach adult size and spawn during the first summer and subsequently produce two generations each year; of van Breemen (1933) that *B. improvisus* may reach maturity and spawn within three months of attachment, but that it normally spawns and dies the following year; and of Moore (1935a) that *B. hameri* spawns only once a year commencing in the second year of life. The fact that none of the first-year specimens of *B. balanus*, taken either from buoys or in dredgings, was in spawning condition suggests that reproduction does not take place in this species also until the second year.

The probability that water temperature is the principal factor controlling the onset of spawning in barnacles of the Canadian Atlantic region is supported by a wealth of evidence, of which some of the most pertinent may be reviewed briefly. The present observations support Hutchin's (1947) description of the progressive delay from south to north of the spawning season of *B. balanoides* on the American Atlantic Coast and show also that the other species of *Balanus* spawn earliest in the south (Woods Hole, Cape Cod Bay), later in the northern part of the Gulf of Maine (Bay of Fundy), and still later off Newfoundland and in the Arctic. The fact that *B. improvisus* spawns earlier in the Gulf of St. Lawrence than in Minas Basin and other estuaries well to the south merely adds to the evidence, for the inshore shallows heat up much earlier in the year in the former than in the latter areas. Also, as noted previously, the spawning season of *B. balanoides* is long drawn out where water temperatures in the spring rise slowly (i.e. at St. Andrews) but is very brief where they rise quickly (i.e. in the Miramichi estuary). Furthermore, spawning and the attachment of cyprids is completed much earlier in barnacle populations of warm shallow water than in those of the same species living in the same locality in deeper and colder water. Finally, all these species spawn much earlier in Europe, where water temperatures are relatively high, than at equivalent latitudes in America, where temperatures are low.

As a result of experiments in the laboratory, Runnström (1927) found that the littoral marine fauna may be classified in the following manner on the basis of temperatures required for normal development:

Region	Range of temperature	Faunal group	Reproductive temperature
Arctic	−2° to 7° C.	Arctic-boreal	−1° to 11° C.
Boreal	3° to 16° C.	Boreal	4° to 16° C.
Mediterranean	15° to 25° C.	Mediterranean-boreal	7° to 23° C.

In applying Runnström's findings to the species of littoral marine barnacles of the Canadian Atlantic region, consideration may be made of the water temperatures previously recorded during the spawning period, during larval occurrence in the plankton, and for the known geographical distribution of the adults on the bottom.

The spawning temperatures of *B. balanoides* previously recorded are less than 10°C.; those obtained from the present study of the reproductive cycle at St. Andrews are less than 7·5°C., and support Hutchins' (1947) conclusions that the southern limit of distribution of this species is marked by a winter minimum monthly mean surface temperature of 45°F. (7·2°C.) above which reproduction is not accomplished. The larvae may be found in somewhat higher water temperatures than this, however; for instance, small numbers were taken by Fish and Johnson (1937) in the Gulf of Maine during July and August when surface temperatures were most probably 12° to 15°C. (Fuglister, 1947). Bassindale (1936) found that the warming of cultures of lab-reared larvae in beakers "kept at a cool even temperature" led to the death of the larvae. Cyprid larvae of *B. balanoides* exhibited a normal positive phototaxis at 13°C. but showed an abnormal negative reaction to light at 16°C. (Stephensen, 1933). All these observations indicate that water temperatures of less than 13°C. are most favourable to larval development in *B. balanoides*, whereas those above 15 to 16°C. are probably lethal. The adult barnacles, however, probably to be ranked among the most eurythermal invertebrate animals, are able to withstand extremely low air temperatures in winter (in the low Arctic), and very high temperatures in the summer (in the south). The species is not found in the high Arctic, however; the northern limit is apparently marked by a minimum monthly mean (summer) surface water temperature of about 40°F. (4·5°C.) (Hutchins, 1947), and probably also by other factors not yet fully known. All these data, therefore confirm the views of Ekman (1953) and others that the temperature requirements of *B. balanoides* are in the main those of an Arctic-boreal species (above).

The range of temperature in which spawning occurs is perhaps somewhat wider in *B. crenatus* than in *B. balanoides*, but evidence from which the precise limits of this range may be estimated is less abundant. In the Arctic and in the deep ice-cold waters of the Gulf of St. Lawrence, spawning probably takes place at very low temperatures (0°C. or less). Surface temperatures in the Gulf of Maine during the early part of the spawning season (April, May) range between 4° and 8°C. (Fuglister, 1947). Maximum spawning temperatures may be of the order of 11° to 12°C., as the spawning of *B. crenatus* in the Miramichi estuary had largely been completed before surface temperatures had attained 15°C. and the spawning adults were located in deeper, colder water. The larvae have been taken in the Gulf of Maine throughout the summer, surface temperatures 14° to 15°C., and in small numbers in the Miramichi estuary in June, water temperatures up to 18°C. The evidence that spawning may normally take place in temperatures of −1° to 12°C., that the larvae occur in temperatures mainly less than 15°C., and that the adults range from the Arctic south only to Long Island Sound in America indicates, therefore, that *B. crenatus* is also an Arctic-boreal species.

The results of plankton tows in the Miramichi estuary are in accord with the previous observations of Broch (1924) and van Breemen (1933) that the main spawning season of *B. improvisus* commences when water temperatures first attain about 10°C., and suggest also that the larvae may not survive at temperatures lower than this. Weiss (1948) observed that the attachment of cyprid larvae in *B. improvisus* of Biscayne Bay, Florida, occurred the year round, water temperatures 18° to 30°C., and that the main attachment period occurred in late winter or early spring when temperatures were between 20° and 24°C. The possibility that different physiological races of *B. improvisus* are involved in the differential spawning times of populations at northern and southern extremities of its range might profitably repay investigation. The range of this species, extending from subtropical northward to boreal regions in both European and American sides of the Atlantic, provides further evidence that the temperature requirements of *B. improvisus* are those of a mediterranean-boreal species.

The widespread occurrence of *B. balanus* in the arctic and in the deep icy cold water of the Gulf of St. Lawrence is indicative that the species normally spawns in very cold water, probably even at −1°C. On the other hand, bottom temperatures may reach 5° or 6° during the main spawning season of this species in the Gulf of Maine (April, early May). The larvae settle in small numbers on buoys at the surface in early June (water temperature 10° to 12°C.), and the newly metamorphosed adult barnacles probably tolerate temperatures of at least 15°C. However, the fact that *B. balanus* does not occur in the warm shallows, although abundant in the cold deeps of the southwestern Gulf of St. Lawrence, denotes that the adults are much less eurythermal than those of *B. crenatus*. Available evidence therefore suggests that the temperature requirements of *B. balanus* most closely approach those of a stenothermal Arctic and Arctic-boreal species.

The adult stages of *B. hameri* have never been taken in negative temperatures (Weltner, 1900)[1], a record maintained by the present investigation also. The spawning season of *B. hameri* in the Gulf of Maine occurs when bottom temperatures are probably about 2° to 6°C., and in Hamilton Inlet to the north at about 1° or 2°C. The species is absent, however, from Arctic and sub-Arctic areas, and has not been taken to date in the ice-cold deeps of the

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[1] Recent studies of the hydrography of Hamilton Inlet (D. C. Nutt, personal communication) show that bottom temperatures range from −1·8°C. in winter to 1·0°C. in summer. The isolated population of *Balanus hameri* living within this range of temperature may be physiologically separable from populations farther to the south.

Gulf of St. Lawrence; on the other hand it does not occur in warm mediterranean areas to the south. The evidence, scanty though it may be, supports the conclusion of Broch (1924) that *B. hameri* is a purely boreal species, and indicates also that this species is stenothermal in all phases of its life history.

The absence from the warm (20°C. in summer) inshore shallows of the entire southwestern Gulf of St. Lawrence region, of *Balanus eburneus*, *B. amphitrite niveus*, and *Chthamalus fragilis*, three southern "Virginian" species requiring a minimum temperature for spawning of about 20°C., may be explained on the basis of winter temperatures unfavourable to the survival of the warm-stenothermal adult barnacles. Many other "Virginian" ("Mediterranean") species, i.e. *Crassostrea virginica, Venus mercenaria,* having similar requirements of temperature for spawning, nevertheless complete their life cycles successfully in this region. Entire populations of these animals living in the shallows and tidal zone (illustrated by the mediterranean-boreal *B. improvisus* in the Miramichi estuary) may be killed by freezing and severe icing each winter, but those in waters that are icy cold, but do not freeze, survive. It seems clear, therefore, that winter conditions in the Gulf are much too severe to permit the survival of *B. amphitrite* having a poleward limit marked by winter monthly mean water temperatures of about 45°F. (7·2°C.), and of *Chthamalus fragilis* having a poleward boundary, probably established by winter monthly mean air temperatures which are above the freezing point. *B. eburneus* ranges somewhat farther north than the other two species, but not into inshore areas where the surface is frozen over and the water is ice cold for a five-month winter period.

The possibility thus arises that a northward spreading of *B. eburneus* into the coastal waters of Eastern Canada might eventually result from the gradual amelioration of winter water temperatures if continued at its present rate.

SUMMARY

The present study provides additional records for the geographical and bathymetrical distribution of the adults and seasonal occurrence of the larvae of the acorn barnacles *Balanus balanoides* (L.), *B. crenatus* Brug., *B. improvisus* Dar., *B. balanus* (L.), and *B. hameri* (Ascan.), and also for the local distribution of goose barnacles (*Lepas* spp.) on the Atlantic Coast of Canada. The occurrence of these species of *Balanus* in the region and the absence of others may be explained in terms of water temperature, salinity, substratum, ocean currents, and other environmental factors which variously influence the survival of the adults, the transport of the planktonic larvae, and the attachment and metamorphosis of the cyprid-stage larvae.

The Canadian Atlantic barnacles may be grouped appropriately into Arctic-boreal, boreal, and mediterranean-boreal species, a classification previously proposed by Runnström (1927) for the northern littoral marine fauna according to the requirements of temperature for reproduction and survival. The fact that the spawning periods of all five species show a progressive seasonal delay, geographically from south to north and bathymetrically from the tide lines down, lends further support to the belief that water temperature is the principal factor controlling the onset of spawning in these invertebrate animals.

The main features of the zoogeography and life history of the species of acorn barnacles in the coastal waters of Eastern Canada may be summarized as follows:

Balanus balanoides, a widely eurythermal, Arctic-boreal, marine species of the tidal zone and inshore shallows of rocky coasts, has a life expectancy of about 3 to 5 years and reaches maturity during the second year. It spawns once a year, mainly from late February to June (water temperatures less than 7·5°C.), and the duration of development of the planktonic larvae occupies four to six weeks (water temperatures below 13°C).

Balanus crenatus, a eurythermal, Arctic-boreal, marine species of shallow to moderately deep water, attains an age of at least 4 years and reaches maturity during the first year, often within three months. It spawns twice a year, mainly from April to June and again in September and October, and larval development takes three to four weeks (water temperatures below 15°C).

Balanus improvisus, a eurythermal, mediterranean-boreal, brackish-water species, occurs abundantly in the shallow inshore waters of the southwest portion of the Gulf of St. Lawrence, in Minas Basin, and in some estuaries of the outer coast of Nova Scotia. It reaches maturity within three months, spawns mainly during June and July, and probably again in September and October (water temperature higher than 10°C.), and again the following year, but usually dies by the end of its second year. The duration of larval life is normally two to three weeks (water temperature between 10° and 22°C).

Balanus balanus, a stenothermal, Arctic and Arctic-boreal, marine species of moderately deep, cold, offshore waters, attains 7 years of age, reaches maturity during its second year, and spawns once a year, mainly from late March to June (water temperature less than 8°C).

Balanus hameri, a narrowly stenothermal, boreal marine species, abundant only in deep offshore waters, may live 8 years, reaching maturity during the second year. It spawns once a year, mainly in April in the southern (Gulf of Maine) and probably in June in the northern (Hamilton Inlet) portion of its geographical range (water temperature probably 2° to 6°C).

The gradual amelioration of water temperature in winter in the northern hemisphere, if continued at its present rate, would probably be attended by a wider occurrence of *B. improvisus* and by the local introduction and establishment of *B. eburneus*, through natural migration or transport by ships, in the Canadian Atlantic region.

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BIRDS OF PRINCE EDWARD ISLAND

By W. Earl Godfrey

INTRODUCTION

Sources of Data. The avifauna of Prince Edward Island has heretofore been neglected by professional ornithologists. Consequently, in 1952, the writer, with the assistance of John A. Crosby, made a summer survey of the birds of that interesting insular part of Canada for the National Museum of Canada. From June 3 to July 13, base camp was at Rollo Bay, near Souris, Kings County. From this base the northeastern corner of the island was covered. In the period July 15 to 27 inclusive, a rapid survey was made of birds in the central and western parts of the island. On July 28 work was resumed from the Rollo Bay base, and observations were terminated on August 6. Notes and specimens secured by the 1952 party have provided the framework of the information presented below on the summer birds, and this is supplemented by a mass of data from many other sources. For information on the birds in spring, autumn, and winter the writer is completely dependent upon the observations of others. Sources of data other than those secured by the 1952 National Museum expedition are in all cases indicated in the text. Much work remains to be done in the autumn, winter, and spring seasons particularly. It is hoped that the present report will stimulate ornithological observation on the island and that observers will publish such additional information as comes to their attention.

Physiography and Vegetation. Prince Edward Island is a low, roughly crescent-shaped insular landmass of 2,184 square miles, situated in the southern part of the Gulf of St. Lawrence between 45° 58′ and 47° 7′N. and 64° 27′W. Its concavity is on the north side facing the open Gulf of St. Lawrence. Its south side is separated from New Brunswick and Nova Scotia by the relatively shallow waters of Northumberland Strait, the narrowest part of this water barrier being about 8½ miles. The island is about 110 miles long, and its greatest breadth is 34 miles. Much of the coast is more or less deeply indented by shallow bays and rivers. The island is almost divided into three. Upper Hillsborough River and Savage Harbour approach each other so closely that the land separating them is little more than 1½ miles wide, and it is similarly constricted between Summerside Harbour and southern Malpeque Bay.

The land is generally low and is gently to moderately rolling in aspect. The highest hills do not much exceed 500 feet. Rivers are fairly numerous, are of necessity short, and, because the land is low, are often little more than arms of the sea which reach inland quite far in some places. Fresh-water lakes and ponds are small.

The names 'Million Acre Farm' and 'Garden of the Gulf' have been applied to Prince Edward Island rather aptly. It is said that 85 per cent of the soil, a fertile red sandy loam, is cultivable. The greater part of the land is now farmland. Agriculture is the main industry of the 97,787 people now inhabiting the island.

Originally the island was covered by an excellent forest. Perhaps, the greater part was coniferous, but there were fine stands of deciduous trees as well. Halliday (1937) includes this forest in the Central Section of his Acadian Forest Region which is characterized by a high percentage of broad-leafed components. Macoun (1894) was impressed by the fine trees during his 1888 work on the island. He contrasted the general distribution of sugar maple and beech in Prince Edward Island with their more limited distribution in Nova Scotia and New Brunswick on more or less elevated ground. He stated that the development of balsam fir and the three spruces he saw on Prince Edward Island was better than anywhere else in Canada. However, Dwight (1893) tells us that when he visited the island in 1892 the cutting of the forests was already well advanced. The timber, he said, had been nearly all cut from the central section where farmland extended from shore to shore. Large tracts remained only in the eastern and western parts where a few black bears still roamed.

Today the original forest is gone. Most of the land is prosperous farmland with broad fields of potatoes, grains, hay, and other crops; extensive pastures grazed by cattle and sheep; and patchy woodlots, usually small and in various stages of immaturity, which supply fuel and some pulp wood.

The woods are composed of spruces (*Picea glauca, mariana,* and *rubens*), tamarack (*Larix laricina*), balsam fir (*Abies balsamea*), pines (*Pinus strobus* and *resinosa*), white cedar (*Thuja occidentalis*), hemlock (*Tsuga canadensis*), maple sugar (*Acer saccharum*), red maple (*Acer rubrum*), birches (*Betula lutea, papyrifera,* and *populifolia*), beech (*Fagus grandifolia*), poplars (*Populus tremuloides, grandidentata,* and *balsamifera*), red oak (*quercus borealis*), white elm (*Ulmus americanus*), and ashes (*Fraxinus americana* and *nigra*). The writer gained the impression that white cedar, hemlock, white and red pine, and white elm are now more numerous in Prince County than in northeastern Kings County, but how much of this is man-made is impossible to determine. Certainly white cedar is still locally quite common in western parts of the island and even in Bain's (1890) time it appears to have been confined to Prince County, and hemlock was not known east of St. Peters.

Much of the present woodland is mixedwood of various ages, although in places there are small good stands of more or less pure coniferous woods, mainly spruces and balsam fir. Good mature stands of hardwood are now few, but the writer examined remnants of such forests still to be found, especially in the northeastern part, which contained enough splendid old examples of sugar maple, yellow birch, and beech to suggest that this type of forest was originally very well developed. Pure stands of either mature coniferous or deciduous woods contain sparser bird populations than most immature stands of mixedwood forests.

Many openings, mostly as a result of cutting, are found in the woods. Where much slashing remains in coniferous woods, there is often a pair of winter wrens. The patchiness and uneven age, which characterize the forest cover, result in a maximum of 'edge effect', and there are good populations of passerine birds in most of the wooded areas. Great expanses of open field, much of it hay meadow and pasture with numerous hedgerows, and much shrubbery about ditches, streams, and wood edges provide excellent and extensive habitat and cover for the numerous bird species that prefer more open areas.

In less exposed places, particularly on the south shore, the coniferous woods often grow undiminished in size to the edge of the coastal cliffs. In more exposed places on the north shore, the spruces approaching the coastal cliffs are sometimes stunted and very asymmetrically developed. In particularly exposed windy places paralleling the cliff tops on the eastern part of the north shore at least, there are long narrow treeless strips. These strips have extensive mats of crowberry (*Empetrum nigrum*) on their outermost side. Farther back from the cliff tops there are large clumps and islands of bayberry (*Myrica pensylvanica*), rose (*Rosa*), and ericaceous plants. Prairie horned larks and eastern savannah sparrows are common on these coastal strips, and large numbers of Hudsonian curlews in southward migration favour them.

Shrubby habitats are well represented on the island. Alders, sometimes with willows, commonly cover broad margins of streams, ponds, and other low moist areas. Other shrubs and small trees include elder (*Sambucus*), red-osier dogwood (*Cornus stolonifera*), Juneberry (*Amelanchier*), mountain ash (*Pyrus americana*), black cherry (*Prunus serotina*), choke cherry (*Prunus virginiana*), pin cherry (*Prunus pensylvanica*), striped maple (*Acer pensylvanicum*), mountain maple (*Acer spicatum*), currants (*Ribes*), raspberry and blackberry (*Rubus*), roses (*Rosa*), juniper (*Juniperus*), yew (*Taxus canadensis*), bayberry (*Myrica pensylvanica*), and many others.

Although for the most part the soil is well drained, there are bogs throughout the island. These bogs often have a scattering of black spruce with alder and tamarack at the edges, sphagnum and other mosses, grasses and sedges with *Eriophorum* often conspicuous, *Ledum*, and other ericaceous plants.

The fresh-water lakes and ponds are small, often with shallow edges well supplied with aquatic and emergent vegetation, with cat-tail (*Typha latifolia*) conspicuous. Aquatics include several species of pondweed (*Potamogeton*). Wild rice (*Zizania aquatica*) has been introduced to Pisquid Pond and perhaps elsewhere. Black Pond, which is a waterfowl sanctuary, is one of the best of the ponds. Such ponds provide excellent food and cover for waterfowl and other birds in which they can raise their broods, and they attract many migrants. The vegetation of the margins of these waters is used also by the eastern red-winged blackbird, American bittern, and sora rail.

The coast has many shallow bays, lagoons, and wide river mouths with broad salt marsh edges and flats exposed at low tide. The great blue heron is characteristic of such places, and myriads of shore birds pause here in their migrations. Gulls, terns, crows, ravens, and grackles often feed in such places. The Acadian sharp-tailed sparrow is locally common in the vegetation of the edges of saline or brackish marshes.

Perpendicular crumbling red cliffs, varying in height from a few to perhaps 100 feet, extend along much of the coast. Great numbers of bank swallows nest in the cliffs which are used also by the black guillemot, belted kingfisher, and even occasionally the starling. European and double-crested cormorants nest and rest on the narrow ledges of the higher cliffs, and the nest of the northern raven also is sometimes situated in such places.

Excellent sand beaches, some of great length, are common coastal features, particularly on the north side, and sand bars and sandy islets are numerous. A very interesting variety of shore bird visits the beaches in migration, particularly in late summer and early autumn. The piping plover is a characteristic breeding bird of the beaches. Gulls and terns frequently rest in such places, and the former, as well as crows and ravens, perform a useful function there as scavengers.

Sand dunes are common and sometimes extensive along the shores and on some islets. On many of the dunes there is a more or less scanty and patchy growth of the grass *Elymus arenareus.* Birds are usually scarce in the dunes, but the common tern nests there in colonies and the eastern savannah sparrow is often seen. All the latter, when possible, were carefully scrutinized for the possibility of the occurrence of the Ipswich sparrow, *Passerculus sandwichensis princeps*, with negative results.

The great expanse of salt water entirely surrounding the island is frequented by a variety of birds such as loons, gannets, cormorants, sea ducks, gulls, and terns, and a few alcids. Farther out from land, doubtless shearwaters, petrels, and jaegers at certain seasons are far commoner than the few records indicate.

In connection with the clearing of the land, the following human population figures are of interest. According to Macphail (1913) there were 2,014 settlers on the island in 1752, most of them Acadians. That the settlements were then very new is indicated by the fact that most of the adult population was not born there. In 1798 there were 4,372 people, and by 1827, following immigration from Scotland, this figure rose to 23,226. By 1841 the population was 47,034; in 1871 it was 94,021; and by 1881 it had risen to 108,891 which was within 187 of the maximum. By 1911 the population had fallen to 93,722. The 1951 census shows only a slight increase in the past 40 years to 97,787.

Climate. The following data, derived from long-term observations at Charlottetown, have been abstracted from *The Climate of Canada,* a publication of the Meteorological Division, Air Services Branch, Department of Transport, Canada. Mean January temperature (Fahrenheit) is 17·8°; mean July temperature, 65·6°. The lowest January temperature ever recorded is −27°; highest July extreme, 98°. The average date of last spring frost is May 13; the average date of first autumn frost, October 22. The average yearly total precipitation (water) is 39·17 inches. Average yearly rainfall is 28·07 inches, and average yearly snowfall is 113 inches. There is an average of 1,857 hours of bright sunshine a year with the maximum occurring in July and the minimum in December.

Previous Literature. The first record of Prince Edward Island birds is that of Jacques Cartier, who, in 1534, noted "many thrushes, stock-doves, and other birds" when he went ashore on the north coast. Reverend George Sutherland (1861) published a four-page section on birds in his manual of the geography and natural and civil history of the island. A small number of birds are mentioned in this by vernacular name. C. Birch Bagster (1861) included in his *Progress and Prospects of Prince Edward Island* an annotated list of about 46 kinds of birds. Neither of these sheds much light on the status of the birds mentioned. In both these little accounts, it is obvious that some species are listed erroneously, and many common ones are not listed. Apparently neither Sutherland nor Bagster made any serious attempt to study the island's bird life.

Francis Bain, a resident naturalist, was the first to make any substantial contribution to Prince Edward Island ornithology. In 1885, an interesting account of the winter birds appeared under his name. His *Natural History of Prince Edward Island* was published in 1890, and this included a small section on the avifauna. This was quickly followed, in 1891, by a delightful little 87-page booklet entitled *The Birds of Prince Edward Island,* in which he recorded about 152 birds. This shows Bain to have been an active and discerning observer with a sincere interest in the subject. Although he made some errors, his intimate pen portraits, awareness of seasonal details, habitat preferences, and elusive little behaviour patterns indicate that he had considerable field experience. It is a pity that he was not more definite in documenting the local occurrences of many of the species he recorded, some of which were approaching extinction or local extirpation even as he wrote. For example, he stated definitely that the spruce grouse occurred on the island, but he did not say how he knew this or whether or not he ever personally saw a specimen either living or dead. It is obvious that he read widely, and, while most of the facts he presented were based on his own personal observations, he drew upon a certain amount of knowledge derived from the writings and conversation of others. Consequently it is now impossible to appraise with certainty the validity of some of his records.

Jonathan Dwight, Jr., in 1893, published a well-annotated list of 81 summer birds, most of which he personally observed in the period June 23 to July 9, 1892. He divided his time collecting specimens between the Tignish and Souris areas, and was in the field from morning to night. Although Dwight's observation covered only a short period, and consequently he missed many species, it has two outstanding advantages over all the other published lists from the island. He was a trained ornithologist, fully cognizant of what information is important and what is not. Even though his list is not a long one, it is in many respects the most valuable of all, for, as far as it goes, it is a *definite* accurate record of the avifauna as it was 60 years ago, with which comparison of present-day conditions can be made. His records show definitely that a number of changes have taken place since the time of his visit there.

John MacSwain, a resident of Prince Edward Island, published in 1908 an annotated catalogue of 203 forms that the author believed he had seen either in the field or as preserved specimens taken by others. This is based, we are told, on his field notes made between 1895 and 1907. The annotations are often too brief and vague to be very useful, and the author was confused by some of the passerines, notably the flycatchers and vireos. The catalogue is perhaps most valuable for the data there recorded on preserved specimens.

In 1916, a briefly-annotated list in tabular form was published anonymously as Bulletin No. 1 of the Rural Science Department of Prince of Wales College. This list, in vernacular names only, contains 228 forms. It is mainly a compilation, apparently by one Professor Macready, from earlier publications.

The late Blythe Hurst, Sr., of Brackley Beach, P.E.I., published in 1947 another list of the birds under vernacular names. Hurst gathered a considerable amount of information from several sources and added this to what he derived from the literature, mainly the 1916 list compiled by

Macready. Ornithology was only one of Hurst's interests, but he was fairly specific in presenting the limited additional information he had and meticulously indicated the sources of his data. His list contains 223 forms, a few of which, however, are included on no other evidence than probability. He appended a list of 17 forms recorded by others but which he thought, wrongly in a few cases, ought not to be included in the Prince Edward Island list. He stated his reasons in each individual case.

A few short articles and notes have appeared in periodicals.

The Bird Fauna. Great changes have come about in the environment of the birds since the days when the Micmac was the sole human inhabitant and a splendid forest covered the land. In destroying the forest, man extirpated the pileated woodpecker. If, as some assert, the spruce grouse was once common, it did not long withstand the new environment of the white man. Gun and axe have greatly reduced the birds of prey: the bald eagle no longer nests there. The Canada jay remains in a few places, and the black-throated blue warbler is confined to the few mature deciduous woods that are left. Man, while greatly reducing the number of winged predators, has introduced new mammalian ones such as the striped skunk (*Mephitis mephitis*) and raccoon (*Procyon lotor*). Numbers of the red fox (*Vulpes fulva*), with the decline of the fox fur industry, have been augmented by animals from the pens of fur farmers and, in spite of a bounty, have increased, to the detriment of colonial ground nesting birds. Two feathered aliens, the English sparrow and European starling, have invaded the island from the mainland, found the man-made environment to their liking, and now compete in numbers with the native birds.

The effect of man is, however, far from being all detrimental to the birds. The present patchy nature and uneven age of the woods create an abundance of 'edge effect', and this undoubtedly has increased the numbers of some of the passerines. The vast cleared fields with their hedgerows and other shrubby margins and patches have probably resulted in larger numbers of birds that prefer such habitat. Man's grain fields and introduced weeds provide food for many, and his buildings furnish nesting places for others. Man has introduced the ring-necked pheasant and European partridge, both of which do well in his farmland environment.

The present status of the northern raven deserves comment. Whereas in the interior of North America it has retreated before the advance of settlement, it remains a relatively common bird in highly-cultivated, thickly-settled Prince Edward Island and perhaps may even have increased. The great black-backed gull appears to have increased substantially since the turn of the century at least as a visitant and non-breeding resident, doubtless as a result of protection accorded it under the Migratory Birds Convention Act. The evening grosbeak, a winter visitant, has been recorded only in recent years.

The evidence is convincing that certain birds have colonized the island in recent historic time. The prairie horned lark, now a common breeding bird, was unknown to observers 60 years ago. The bronzed grackle, now abundant throughout the island, also appears to be a recent arrival and perhaps this is true of the red-winged blackbird.

Certain species that occur in New Brunswick are either excessively rare or absent in both Prince Edward Island and Nova Scotia as, for example, the red-shouldered and broad-winged hawks, screech owl, eastern phoebe, house wren, eastern bluebird, warbling vireo, and eastern meadowlark.

In general the avifauna is characteristic of the Canadian Life Zone. The catbird, locally common in Nova Scotia's Annapolis Valley, which has many Transition Life Zone affinities, apparently has not successfully colonized Prince Edward Island. Despite the abundance of apparently suitable habitat in the island for the bobolink, that bird appears to be no more than a straggler there, although locally common in the peninsula of Nova Scotia. Three species, the eastern mockingbird, chestnut-sided warbler, and eastern grasshopper sparrow, which were collected in 1952 there and which have not been recorded there previously, are all of definitely more southern affinities. No unusual meteorological conditions are known to account for their presence.

Comparison of the Prince Edward Island list with that of Nova Scotia shows the former to lack most of the species of tropical or sub-tropical origin that have been gale-borne to Nova Scotia. This may be due in part to the paucity of observers in Prince Edward Island and in part to its geographical position, sheltered as it is by land on three sides.

Post-Pleistocene Colonization. Prince Edward Island appears to have been completely glaciated in Pleistocene time, but in parts perhaps not heavily (Milligan, 1949). It would seem very unlikely that any refugium existed for birds. Probably Northumberland Strait was not a very effective barrier to post-Pleistocene colonization by most birds, now known to occur on the island, which, with the possible exception of the ruffed and spruce grouse, could and would cross this barrier by flight. The English sparrow and European starling quickly colonized the island after they became established on the adjacent mainland, and the prairie horned lark and bronzed grackle appear to have become established as breeding birds on the island within recent historic time.

It seems possible, however, that a post-Pleistocene land bridge with the mainland might have existed for a time. Although the writer knows of no comprehensive surveys of the mammals, reptiles, amphibians, freshwater and land molluscs, etc., enough of these is known to indicate that they are relatively well represented on the island. Weighing of the evidence in detail for and against the existence of a former land connection with the mainland far transcends the limits imposed by the nature of the present paper since most of the evidence is not ornithological.

It is true that the island is well situated geographically to receive animal colonizers (in addition to birds) that might travel across the water barrier from the adjacent mainland on natural rafts, and this is favoured by the southwest winds that prevail in summer. Winter ice-bridges offer a crossing to animals that remain active throughout the year. The relative richness of the faunas and particularly the presence of certain forms, not readily otherwise explainable, suggest the possibility of a post-Pleistocene land connection. (Since the writer mentioned above that the eastern raccoon and striped skunk were introduced by man to the island, and their natural absence might be construed as evidence against the existence of a land bridge, it might be well to point out that according to Gilpin (1868) the raccoon and skunk first appeared in Nova Scotia within recent historic time. Presumably, therefore, they would have been unable to utilize a former land bridge to Prince Edward Island.)

The convincing evidence of Goldthwait (1924) and Johnson (1925) that the last important change of coast level in the Acadian – New England region was one of submergence may have significance in this connection, particularly when it is recalled that parts of the western end of Northumberland Strait are only shallowly submerged at the present time.

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SYSTEMATIC LIST

In evaluating sight records the writer has taken into account, among other things, the experience of the observer, the degree of similarity in the field of the bird identified to birds of other species, the conditions under which the bird was observed, and the known distribution of the species concerned. Sight records have been accepted of readily identifiable species seen by experienced observers under favourable conditions. Even by these admittedly flexible standards, it is unfortunate that of the 255 forms in the following list, the previously recorded occurrence of no less than 40 forms must be considered either hypothetical or erroneous. It may well be that many of these represent correct identifications, but this cannot now be established in many cases because the author was not specific in stating the pertinent details.

It will be understood that all data for which no source is indicated are those of the 1952 National Museum field party. Numbers enclosed in parentheses following a date are numbers of bird individuals recorded on that date.

Common Loon. *Gavia immer* (Brünnich)

Permanent resident. This loon was recorded in 1952 at Fortune River, June 18 (1); Swallow Point, June 21 (1); Souris Head, June 29 (2); McKinnon Point, July 6 (1); Greenhill, July 16 (1); North Point, July 18 (1), 25 (9); Campbell Cove, July 31 (5); Cable Head, July 31 (1). Both Bain (1891) and MacSwain (1908) stated that it breeds, and Bain (1891) asserted that it winters.

Red-throated Loon. *Gavia stellata* (Pontoppidan)

Transient and winter resident. Recorded by Bain (1891), MacSwain (1908), and Hurst (1947). Goodwill (MS.) observed one off Murray Head, Kings County, on October 26, 1947; and two off Wood Island, Queens County, on November 13, 1948.

Holboell Red-necked Grebe. *Colymbus grisegena holböllii* (Reinhardt)

Transient. Goodwill (MS.) in 1947 recorded this species in the Murray Harbour area as follows: one on October 23, seven on October 26, one on October 27, and two on October 29. On September 3, 1948, he noted one off Howe Point, Kings County. Macoun and Macoun's (1909) record of "large flocks seen on Prince Edward Island, August 8th, 1888" seems questionable.

Horned Grebe. *Colymbus auritus* Linnaeus

Transient. Goodwill (MS.) recorded it in 1947 as follows: two at Murray Head on October 23 and three there on October 26; and at Cape Bear he saw two on October 28.

Pied-billed Grebe. *Podilymbus podiceps podiceps* (Linnaeus)

Fairly common summer resident locally about shallow fresh-water ponds and small lakes; breeds. It was observed at Black Pond Sanctuary on several dates, and on August 3 eleven, including both adults and young, were counted there. It was observed also at Campbell Pond, July 17 (2); Cavendish, July 17 (2); near Brackley Beach where on July 17 one adult was seen passing food to a young bird; Stanhope, July 27 (1); East Lake, July 30 (5); Deroche Pond, August 4 (1); and one was seen at Little Harbour, and one at Fortune River on August 5. Flightless young were observed near Brackley Beach and at Black Pond. Addy and Boyer (MS.) found a nest containing five eggs at Pisquid Pond on July 23, 1949. MacSwain (1908) was the first to record it, and he considered it rare then. Sterns (*in* Hurst, 1947) considered it common at East Lake each year and thought it probably breeds.

Sooty Shearwater. *Puffinus griseus* (Gmelin)

Summer visitant probably not uncommon in offshore waters. The only record is that of a specimen mounted by Calder in 1904 and recorded by MacSwain (1908). The Greater Shearwater, *Puffinus gravis* (O'Reilly), should be looked for in offshore waters.

[**Storm Petrel.** *Hydrobates pelagicus* (Linnaeus)

Hypothetical. MacSwain (1908) referred a specimen taken in 1905 and two collected in 1906 to this Old World species. Because of the similarity of this to other petrels of more probable occurrence and the possibility of erroneous identification, the Storm Petrel seems best placed on the hypothetical list.]

Wilson Petrel. *Oceanites oceanicus oceanicus* (Kuhl)

Summer visitant, probably not uncommon off the coasts. Bain (1891) stated that it is occasionally blown ashore during storms. According to MacSwain (1908) it is occasionally found on the north coast. Local fishermen told the writer in 1952 of occasionally seeing petrels several miles off shore which might have been this species or the following.

Leach Petrel. *Oceanodroma leucorhoa leucorhoa* (Vieillot)

Summer visitant. Occasionally blown ashore during storms according to Bain (1891). It probably is at times not uncommon off shore, but there is no evidence that it breeds on the island.

Gannet. *Morus bassanus* (Linnaeus)

Transient and summer visitant coastally. Gannets were observed by the writer in 1952 off East Point, June 16 (23), 22 (66), July 4 (19), 9 (16); 30 (10); off North Point, July 18 (1), 25 (31); and in much smaller numbers off Port Borden, Swallow Point, Cavendish, Campbellton, Cape Bear, White Sands, High Bank, and MacPherson Creek in June and July. Hurst's (1947) hearsay report that it breeds on the island is probably erroneous. The writer examined all apparently suitable breeding places in 1952 and found no evidence of breeding. Goodwill (MS.) observed many in his four field seasons on Prince Edward Island; his seasonally latest observation was two off Summerside on November 2, 1951.

European Cormorant. *Phalacrocorax carbo carbo* (Linnaeus)

Common coastal summer resident; breeds. Peters (1942) was the first to record the breeding of this species in Prince Edward Island. On June 11, 1941, he observed a colony of breeding cormorants at Cape Tryon which then contained about twenty-five nests of *carbo* and seventy-five of *auritus*. On July 17, 1952, about thirty-five nests of *carbo* were counted there, indicating a slight numerical increase. The writer observed three additional colonies of *carbo* at East Point, McKinnon Point, and Durrell Point, respectively, all in Kings County. At East Point, thirty-four nests were counted and no double-crests were seen at nests. Accurate nest counts at McKinnon Point were impossible without a boat. However, from the top of the nesting cliffs at McKinnon Point, thirty-one nests and about 110 birds were seen. Although a few individuals of *auritus* were present, all birds seen actually at nests were *carbo*. At Durrell Point only nineteen nests were seen, but obviously some could not be seen from the cliff tops and were missed. Most nests observed were on shelves in the cliffs, but two at McKinnon Point and four at Durrell Point were in low, dead white spruces. Goodwill (MS.) on June 20, 1948, found two nests and one apparently abandoned nest between Souris Head and Sheep Head, Kings County. J. Frank Sterns was familiar with the colonies at East Point and McKinnon Point. He told the writer in 1952 that the East Point colony was between 15 and 17 years old and that the McKinnon Point colony had existed for many years. He was not familiar with the colonies at Durrell Point and Cape Tryon.

All these colonies were unrecorded when Lewis (1941) estimated a total of 2,172 European cormorants known to breed in North America. At least 242 known to have bred in Prince Edward Island in 1952 can now be added to that total.

Specimens examined:

East Point: 1 ad. ♂, 1 ad. ♀; July 4, 1952.

Double-crested Cormorant. *Phalacrocorax auritus auritus* (Lesson)

Common coastal summer resident; breeds. The only breeding colony of this species seen by the writer was that at Cape Tryon; this was first recorded by Peters (1942). Peters found about seventy-five nests of this species there in 1941, and about eighty-seven were counted there on July 17, 1952. A few birds were seen about the colonies of *carbo* at East Point and McKinnon Point, but no evidence that they breed there was secured. This species appeared to be greatly outnumbered by *carbo* in the northeastern part of the island, but the reverse was true at Cape Tryon. Near Cavendish Inlet, Prince County, large numbers of double-crests were noted also.

Great Blue Heron. *Ardea herodias herodias* Linnaeus

Common summer resident; breeds. Hurst (1947) listed heronries at Midgell, Judson's Island (Alexandria), Granville, Bedeque, Glen William, Stanley Bridge, Springfield, Fortune Head (200 to 300 nests), and Rustico Island. Bain (1891) spoke of a noted heronry at the head of Howell's Brook. The writer saw a heronry at Squaw Bay in which at least fourteen nests were counted, but as this colony could not be closely approached without a boat, probably a number were missed. Fishermen said this heron breeds on Savage Island, Prince County. It is characteristic of the shallow water margins of the bays and river estuaries, and was observed daily in suitable habitat throughout the island. It remains well into autumn as Goodwill (MS.) saw it regularly throughout October, 1947; his latest observation was of five in the Murray Islands on October 29.

Black-crowned Night Heron. *Nycticorax nycticorax hoactli* (Gmelin)

Rare summer visitant. MacSwain (1908) examined a young specimen shot at Mount Stewart, date unknown. Crosby and the writer observed an immature in flight in the early evening of July 22, 1952, at Cavendish Inlet. It was not seen there on the following day. On July 24, however, probably the same individual was observed at the same place, and this time, as it flew low over the marsh in good light, it was definitely identified as this species, not *Nyctanassa* which the writer has collected four times in nearby Nova Scotia (Godfrey, 1938). This individual alighted in extensive marshes 1½ miles away, but a two-hour search failed to flush it, and it was not collected.

American Bittern. *Botaurus lentiginosus* (Rackett)

Not uncommon summer resident; breeds. The writer recorded it at Little Harbour, Fortune River, Dunk River, West Point, Brackley Beach, near Lennox Island, O'Leary, Miminegash, Tignish, Cable Head, Schooner Pond, and Black Pond. Four was the largest number seen in a day. First flying young were noted on July 25 at Tignish.

[**Glossy Ibis.** *Plegadis falcinellus* subsp.

Hypothetical. Brewer (1881) reported the occurrence in Prince Edward Island in August, 1878, of several 'black curlews'. One was shot but unfortunately was not preserved and apparently was never examined by an authority. It seems significant, however, that no less than three specimens were collected that year in Massachusetts (Bull. Nuttall Orn. Club, 1878, 3(3): 151-152).]

Whistling Swan. *Olor columbianus* (Ord)

Very rare transient. One was shot on October 7, 1885, at Wheatley River according to Bain (1886 and 1891), who examined the specimen and gave some measurements. MacSwain (1908) stated that the specimen was mounted and that it was extant at the time he wrote. Forbush (1912) reported that E. T. Charbonnell had observed several flocks about Charlottetown "in recent years" and that one flew over that city in 1909.

Eastern Canada Goose. *Branta canadensis canadensis* (Linnaeus)

Common spring and autumn transient, wintering irregularly in varying numbers. Recorded by Bain (1891), MacSwain (1908), and Hurst (1947). In 1943, Peters (MS.) recorded about 1,000 at Dunk River on May 9 and some 600 there on May 14. Bain stated that a few winter. J. Frank Sterns (oral) informed the writer that a small number wintered in 1951–52 at Rollo Bay and (in litt., February 16, 1953) that in the unusually mild winter of 1952–53 about 400 were wintering at Rollo Bay and about 100 at South Lake.

Specimen examined:

Mount Stewart: spring, 1936; J. Spurgeon Jenkins.

Unquestionably a smaller race has occurred as a transient from time to time. MacSwain (1908) recorded occasional individuals which he called *Branta canadensis hutchinsi* (Swain and Rich.). J. Spurgeon Jenkins (in litt.) wrote that, "About 20 years ago, whilst I was employed by the then Dept. of Interior, Ottawa, I saw a flock of geese in Moss Lake near my old home at Mount Albion, P.E.I. There were 6 in the flock . . . 5 about the same size as brant . . . miniature Canada geese, while the sixth was an ordinary Canada Goose. The comparison was startling for they didn't look much larger than adult ducks." He cited several other instances of the occurrence of such small geese in the Province.

One small goose was shot in autumn, 1950, but unfortunately was not preserved. H. R. Webster (in litt.) examined this and informed the writer that it was an immature female weighing 4 pounds, 10 ounces, and that its measurements were, in inches: length, 27·6; wing, 15·1; tarsus, 3; bill, 1·6. These dimensions seem a little large for an immature *hutchinsii*, and the writer is reluctant to attempt to identify it racially without personally examining it.

American Brant. *Branta bernicla hrota* (Müller)

Spring and autumn transient: common in spring, less common in autumn. Bain (1891) stated that in spring it arrives soon after the ice breaks up, that June 6 is usually the latest spring date, and that it is infrequently seen during its autumn migration. The writer observed it at the mouth of Souris River where numbers varied between fifty-six and 103 from May 31 to June 4; twenty-one were seen at Squaw Bay on May 30, and two near Stanhope on June 1. On July 18, a surprising date, one was seen at Tignish, perhaps an injured bird.

White-fronted Goose. *Anser albifrons* subsp.

Casual visitant. Hurst (1947) stated, on the competent authority of Robie W. Tufts, that one was taken near Summerside in 1925. Mention of the rare occurrence of the species is made also by Bain (1891) and MacSwain (1908). The race or races to which these belong are unknown.

[**Snow Goose.** *Chen hyperborea* subsp.

Hypothetical. Bain (1891) asserted that individuals of this species are sometimes seen. This may well be correct but unfortunately the evidence is vague.]

Blue Goose. *Chen caerulescens* (Linnaeus)

Accidental. Hurst (1947), on the authority of Ludlow Jenkins, reported one taken alive at Summerside about 1910. He stated that five were seen by J. Frank Sterns at Souris in November, 1933. The writer discussed this with Mr. Sterns and is convinced that there could have been no mistaking the Souris birds.

Mallard. *Anas platyrhynchos* subsp.

Casual autumn visitant. MacSwain (1908) included this duck in his list stating without details that it is of rare occurrence. Hurst (1947) gave Ludlow Jenkins as his authority for the statement that several were shot in the autumn of 1933. A. F. Calder (oral) mounted a male taken at the head of Hillsborough River on November 1, 1941. Peters (MS.) noted that several were reported seen in autumn, 1938.

Black Duck. *Anas rubripes* Brewster

Common spring, summer, and autumn resident; winters in varying numbers; breeds. The writer found this duck in marshes all across the island. Broods of young were seen on June 9 at the head of Fortune River; July 8 at Black Pond; July 17 at Cavendish; July 18 at Little Tignish River; July 24 near Cavendish Inlet; July 26 at Campbell Pond. On August 3, fifty-four adults and young were counted at Black Pond and on August 5, fifty-two were seen at the head of Fortune River. Goodwill (MS.) noted 300 on Black Pond on August 29, 1948. Hurst (1947) stated that it winters every year in eastern Kings County and that it was abundant in the winter of 1937–38.

[**Gadwall.** *Anas strepera* Linnaeus

Hypothetical. MacSwain (1908) stated that it is rare. Hurst (1947) recorded two shot at Basin Head in autumn, 1929; also specimens in 1930 and 1932. Peters (MS.) was told by Jenkins that the latter saw two in autumn, 1935 or 1936; that several were shot by Corp. Hearst near Souris in autumn of 1938 and that several others were seen at the same time. Unfortunately no specimen appears to have been preserved, and it seems best to place the species in the hypothetical list.]

American Pintail. *Anas acuta tzitzihoa* Vieillot

Spring and autumn transient. MacSwain (1908) recorded it as uncommon. Hurst (1947) was told by the late Ludlow Jenkins that "several were taken at Morson's Mill, and at Lot 48, in the fall of 1932". J. Frank Sterns saw a female at Basin Head on June 6, 1937. Harold S. Peters (MS.) saw a pair near New Glasgow at Campbell Pond on May 11, 1943, and recorded that the species is occasionally seen by hunters in the autumn. On August 23, 1946, he saw ten at Pisquid Pond, Kings County. Boyer and Addy (MS.) observed five on Dunk River on July 22, 1949.

Green-winged Teal. *Anas carolinensis* Gmelin

Spring and autumn transient and uncommon summer resident; breeds. Although Bain (1891), MacSwain (1908), and Hurst (1947) considered it to be merely a transient, fairly common in spring and autumn, they did not mention its summer status. Dwight (1893) did not record it. In 1952, the writer recorded it as follows: June 27 (two at Big Pond); July 4 (twelve at East Lake); July 16 (four at West Point); July 17 (six at Cavendish); August 5 (twenty-eight at the head of Fortune River, many of which were birds of the year). Goodwill (MS.) saw about fifty on August 22 and 29, 1948, at Black Pond. Peters (MS.) recorded that Jenkins told him that the species was first known to nest on the island in 1937. Peters noted one near East Lake on June 8, 1940; saw seven on Black Pond and four at East Lake on May 10, 1943; and noted two males and a female, evidently with young, on July 21, 1943, at Black Pond.

Blue-winged Teal. *Anas discors* Linnaeus

Not uncommon summer resident; breeds. Bain (1891) and MacSwain (1908) wrote vaguely of its occurrence, and Dwight (1893) did not record it. Hurst (1947) first recorded the breeding of this duck, a nest at Bunbury found in 1939. Peters (MS.) photographed a nest with eleven eggs on June 12, 1941, at Black Pond. In 1952, the writer observed nine flightless young near Wheatley River, July 17; eleven at Schooner Pond, August 2; nine at Black Pond on July 29, and eight there on August 3. Adults in various numbers were seen at St. Peters, Mount Stewart, Harmony Junction, East Lake, Murray Harbour, Campbell Pond, Cavendish, and Deroche Pond, as well as in the localities mentioned in connection with flightless young. Goodwill (MS.) saw 176 at Black Pond on August 22, 1948.

European Widgeon. *Mareca penelope* (Linnaeus)

Rare autumn transient. Lloyd (1937) reported the shooting of one near Hopedale on September 26, 1936, which was banded as a young bird on August 4, 1936, in northern Iceland.

Shoveller. *Spatula clypeata* (Linnaeus)

Rare visitant. Ludlow Jenkins informed Hurst (1947) that one was shot at North Lake in autumn, 1932. Harold S. Peters (MS.) recorded two at Pisquid Pond on August 23, 1946. H. R. Webster, Canadian Wildlife Service (in litt.), observed a male at Black Pond between May 13 and 16, 1952.

Wood Duck. *Aix sponsa* (Linnaeus)

Rare summer resident; probably breeds. MacSwain (1908) saw one in 1893. Hurst (1947) was informed by J. Spurgeon Jenkins that several were seen in 1938 and 1939. Peters (MS.) saw one at Black Pond on August 22, 1946, and two at Pisquid Pond on the following day. John Crosby observed fourteen at Schooner Pond on August 2, 1952. He watched them at about 45 yards through a telescope and a binocular. One was an adult female, but because of the extension of white pattern into the cheek and side of neck, most of the others were thought to be males. Plumage was well developed, and at least one was seen in flight so it could not be determined definitely that these immatures were raised on the island, although this seems probable. A. F. Calder (oral) has mounted about three locally-taken specimens in the past 40 years.

Redhead. *Aythya americana* (Eyton)

Rare visitant. J. Spurgeon Jenkins stated (in litt., February 5, 1951) "Five or six years ago I was given a duck to identify by a gunner who shot it at Pisquid Pond, at Peakes in Kings County, P.E.I. It was a Red Head and is now in the collection of birds of Prince Edward Island at the Prince of Wales College, Charlottetown". The writer examined this specimen in 1952.

Ring-necked Duck. *Aythya collaris* (Donovan)

Not uncommon summer resident; breeds. J. Spurgeon Jenkins was the first to recognize this duck in Prince Edward Island, and Harold S. Peters (1941) was first to record its occurrence and breeding there. Suspicious that birds he had observed in the early 1930's were this species, Jenkins collected three specimens in autumn, 1939, and forwarded them to the National Museum for confirmation. With regard to its earlier occurrence, Jenkins (in litt.) stated, "I know now that I shot Ring-necks in P.E.I. in 1908 or 1909." The writer observed this duck regularly on Black Pond during the 1952 studies there, saw two broods of flightless young, and counted forty-four individuals on that pond on August 3. It was also recorded at East Lake, July 4 (1); Campbell Pond, July 17 (5) and 26 (4 adults and 3 well-grown young); Cavendish, July 26 (3); and Big Pond, August 2 (1).

Specimens examined:

Charlottetown: 3 imm. unsexed; October, 1939; J. Spurgeon Jenkins.

[**Canvas-back.** *Aythya valisineria* (Wilson)

Hypothetical. Hurst (1947) gave a vague report of two which, according to Ludlow Jenkins, were shot at Alexandria Bay in 1910.]

Greater Scaup Duck. *Aythya marila* (Linnaeus)

Uncommon transient and scarce non-breeding summer resident. MacSwain (1908) and Hurst (1947) call this duck a rare spring and autumn migrant, without further details. In 1952, on July 17 the writer observed five near Cavendish. Considerable trouble was taken to identify them, and they were observed through a 40X telescope in good light at about 110 yards. They were identified as this species. Goodwill (MS.) observed twenty on the water of Brackley Bay on May 20, 1950, which he considered to be this species. Peters (MS.) saw ten scaups near Summerside on May 12, 1941; and, in 1942, a pair on Black Pond on May 8, and three pairs at French Village on May 10, under circumstances which precluded species determination.

[**Lesser Scaup Duck.** *Aythya affinis* (Eyton)

Hypothetical. While the writer does not doubt the probability of the occurrence of this species as a transient in spring and autumn, its occurrence is not yet established by MacSwain's (1908) vague comment that it is no commoner than the Greater Scaup. Some of the unidentified scaups listed above might have been this species. Peters (MS.) saw ten on Black Pond on May 10, 1943, which he recorded as possibly being of this species.]

American Golden-eye. *Bucephala clangula americana* (Bonaparte)

Not uncommon permanent resident. In 1952, the writer observed this duck at Black Pond on May 31 (6), June 10 (9), 14 (2), July 30 (6), August 3 (12); near Hermanville, June 13 (2); Little Harbour, June 29 (2); Cavendish, July 26 (2). Young of the year were seen at Black Pond on August 3, but it could not be determined that they were still flightless. Bain (1885) stated that it is present in mild winters and probably it winters regularly.

Barrow Golden-eye. *Bucephala islandica* (Gmelin)

Transient and winter visitant. Two shot at St. Peters Bay in spring, 1904, were recorded by MacSwain (1908). A. F. Calder (oral) shot one on St. Peters Island in 1908. The writer saw a mounted male in the Prince of Wales College collection which he was assured was taken locally.

[**Buffle-head.** *Bucephala albeola* (Linnaeus)

Hypothetical. Although both Bain (1891) and MacSwain (1908) refer to it as a transient, their statements are vague and one cannot be sure that either had ever actually examined a specimen. It is known to be an uncommon visitor to the other Maritime Provinces, and there is no obvious reason why it should not occur similarly in Prince Edward Island.]

Old-squaw. *Clangula hyemalis* (Linnaeus)

Spring and autumn transient and winter resident. Goodwill (MS.) in 1947 saw eight in the Murray Harbour area on October 16 and noted it in numbers between one and seventy-nine on later October dates. Bond and Ross (MS.) observed one at North Point on June 14, 1949, a very late date for spring. Bain (1888) occasionally saw it in mild winters. Hurst (1947) stated that it occurs from November to April.

Eastern Harlequin Duck. *Histrionicus histrionicus histrionicus* (Linnaeus)

Rare transient. Although heretofore apparently unrecorded from Prince Edward Island, A. F. Calder (oral) mounted a male and a female collected by him on May 2, 1914, at St. Peters Island. The writer is indebted to J. Frank Sterns for a clipping from *The Charlottetown Guardian*, January 21, 1953. This contains a readily identifiable picture of a mounted harlequin duck which, the caption states, was shot at Wilmot River by Gordon Heustis on the last day of the hunting season. This was November 26, 1952. The bird was sent to A. F. Calder who correctly identified and mounted it.

American Eider. *Somateria mollissima* Linnaeus

Fairly common spring and autumn transient and summer resident but not known to breed. Probably winters. Bain (1891) and Hurst (1947) recorded it in spring and autumn. It occurs also throughout the summer, but the writer has no evidence of breeding. Most of the records are coastal, but Crosby and the writer saw one on Hillsborough River, some two miles east of Mount Stewart on June 5. We observed it also near East Point, June 22 (14); Miscouche Point, July 15 (3); North Point, July 18 (11); and off Cape Tryon, July 26 (2). It was noted by Bond and Ross (MS.) at North Point on June 14, 1950. Goodwill (MS.) observed it a number of times in Kings County during June and July, noting forty on July 8, 1948. Presumably most of these belong to the subspecies *dresseri*, but *borealis* probably also occurs in migration and perhaps in winter.

White-winged Scoter. *Melanitta deglandi deglandi* (Bonaparte)

Fairly common spring and autumn transient, uncommon non-breeding summer resident. Probably winters. Its occurrence on the north coast was mentioned by MacSwain (1908). Hurst (1947) recorded an observation by Robie W. Tufts of many between Port Borden, P.E.I., and Cape Tormentine, New Brunswick, on June 18, 1934. Bond and Ross (MS.) observed it near Port Borden on June 13, 1949. The writer saw, in 1952, nine off Shipwreck Point on June 14, and one off North Point on July 18. Goodwill (MS.) saw 110 on June 13 and seventy on June 17, 1948, off northeastern Kings County.

Surf Scoter. *Melanitta perspicillata* (Linnaeus)

Fairly common spring and autumn transient and uncommon non-breeding summer resident. Hurst (1947) stated that it is common in autumn and that one was shot at Brackley Point in November, 1940. On June 10, 1952, the writer recorded three flocks off Basin Head numbering two, sixteen, and seventy-five, respectively. Goodwill (MS.) noted twenty-one on September 24, 1947, off White Sands, Kings County, and noted the species in smaller numbers on five other dates until October 25. Peters (MS.) recorded about 500 off Cape Tryon on May 11, 1943.

American Scoter. *Oidemia nigra americana* Swainson

Uncommon spring and autumn transient, winter resident, and non-breeding summer resident. MacSwain (1908) referred to it vaguely as being rare. Hurst (1947) called it a winter resident. The writer observed five males off Cape Tryon on July 17, 1952.

Ruddy Duck. *Oxyura jamaicensis rubida* (Wilson)

Rare visitant. MacSwain (1908) stated that he saw a mounted specimen, but it is not clear whether the date he gave (October 4, 1904) was the one on which he examined the mounted specimen or the time it was taken. Hurst (1947) personally observed it on November 10, 1937, and December 5, 1944, but gave no definite locality. A. F. Calder (oral) collected one in 1914 and has observed the species occasionally in autumn. Hurst (op. cit.) recorded a pair at Basin Head on May 23 and again on June 6, 1937. Harold S. Peters (MS.) observed one at Black Pond Sanctuary on May 10, and one at the same place on July 21, 1943. The writer saw a fine male which showed no obvious signs of moult on Black Pond Sanctuary on July 29, 1952. It could not be found there next day nor on other later visits, nor was it observed during previous visits there when this pond was carefully scrutinized. These June and July records are surprising. Peters (MS.) was told by Jenkins in 1940 that the latter shot one about 1932 and that another was taken at Southport in 1937.

Hooded Merganser. *Lophodytes cucullatus* (Linnaeus)

Rare visitant. Hurst (1947) recorded one shot in autumn, 1934, but gave no locality. A. F. Calder (MS.) shot a male in Summerside Harbour on September 15, 1938. Harold S. Peters (MS.) saw a pair at Black Pond sanctuary on May 8, 1942. At Black Pond sanctuary also, Crosby and the writer observed an adult female or an immature on July 30, 1952.

American Merganser. *Mergus merganser americanus* Cassin

Resident probably throughout the year but, in summer at least, much less common than the red-breasted merganser. The writer's only observation was of one at Squaw Bay on May 31. Probably it is commoner at other seasons, for the writer saw mounted specimens in Prince of Wales College which were said to have been taken locally. Peters (MS.) saw three pairs near Summerside and one pair at Vernon River in mid-May, 1943; eleven individuals at East Lake, May 12, 1944; a flock of twenty near Souris on May 8, and about twenty at East Lake on May 11, 1946. Hurst (1947) stated that it breeds.

Red-breasted Merganser. *Mergus serrator serrator* Linnaeus

Common spring, summer, and autumn resident; breeds; perhaps some winter. This is by far the commonest merganser in summer. The writer recorded seventy-two individuals in June and one hundred and eleven in July, 1952, in various parts of the island. A brood of six young was seen at Big Miminegash Pond, Prince County, on July 26. Goodwill (MS.) recorded it in spring, summer, and autumn in numbers similar to the writer's. It seems strange that Dwight (1893) failed to record it. Hoag (1894) recorded a set of ten fresh eggs collected on Cherry Island, near Alberton, on June 11, 1894. It was said to have nested regularly on that island in each of the eight immediately preceding years. Bent (1923) gave April 21 as the average date of spring arrival, with April 15 as the earliest date. Bain (1891) stated that mergansers occasionally winter but did not specify the species.

Eastern Goshawk. *Accipiter gentilis atricapillus* (Wilson)

Uncommon permanent resident; breeds. Apparently it is commoner as a transient and winter resident than in summer, for heretofore only Bain (1891) mentioned its occurrence in summer. In the National Museum there are three short-tailed juvenals, collected from the nest in the Millvale district, Queens County, on June 20, 1938, together with both parents, by J. Spurgeon Jenkins. This definitely establishes breeding. Bond and Ross (MS.) observed it in Prince Edward Island National Park on June 16, 1949.

Specimens examined:

Millvale district : 1 ad. ♂, 1 ad. ♀, 3 juv.; June 20, 1938; J. Spurgeon Jenkins.

Eastern Sharp-shinned Hawk. *Accipiter striatus velox* (Wilson)

Uncommon spring, summer, and autumn resident; breeds. MacSwain (1908) stated that it breeds. In 1952, the writer observed single birds near Souris on June 17; Swallow Point, June 20; St. Peters, June 26; Cable Head, July 31; and Haliburton, July 21. Goodwill (MS.) noted singles in the Murray Harbour area on September 17, 18, and October 13, 1947.

[**Cooper Hawk.** *Accipiter cooperii* (Bonaparte)

Hypothetical. Bain (1891) implied that it was of regular occurrence, but because he did not mention the occurrence of the sharp-shin it seems likely that he confused the two. MacSwain (1908) stated that it is rare. Goodwill (MS.) noted one near the entrance to Charlottetown Harbour on July 24, 1951. Prince Edward Island is included in the breeding range summary of the A.O.U. Check-list (1931). Considering how readily this species may be confused with the sharp-shinned hawk, it seems best to regard its occurrence as hypothetical until a specimen is taken.]

Eastern Red-tailed Hawk. *Buteo jamaicensis borealis* (Gmelin)

Rare summer resident; breeds. The comments of Bain (1891) and MacSwain (1908) suggest that this fine and generally beneficial hawk was formerly commoner than it is today, although Dwight (1893) did not record it. In 1952, the writer observed only one, an adult at Hermanville on June 17. Its breeding on the island is established by a downy-juvenal and its female parent, taken in 1938 at Fredericton, Queens County, by J. Spurgeon Jenkins.

Specimens examined:

Fredericton: 1 ad. ♀, 1 downy-juv.; summer, 1938; J. Spurgeon Jenkins.

The adult, although referred to *borealis*, is not typical because of its *calurus*-like barred tail.

[**Northern Red-shouldered Hawk.** *Buteo lineatus lineatus* (Gmelin)

Erroneously recorded. There is a vague mention of its occurrence by Bain (1891). The A.O.U. Check-list (1931) includes both Nova Scotia and Prince Edward Island in the breeding range of this hawk. R. W. Tufts (oral) investigated alleged records for Prince Edward Island and found them erroneous. Hurst (1947) excluded it from his list.]

American Rough-legged Hawk. *Buteo lagopus s.-johannis* (Gmelin)

Transient and winter resident. MacSwain (1908) saw one winter specimen but recorded little definite information concerning it. A. F. Calder (oral) collected two on October 10, 1909, at Governor Island.

[**Broad-winged Hawk.** *Buteo platypterus* (Vieillot)

Hypothetical. Included in the lists of Macready (1916) and Hurst (1947), apparently only because these authors thought it should occur.]

Golden Eagle. *Aquila chrysaëtos canadensis* (Linnaeus)

Rare visitant. Dwight (1893) examined a living immature specimen captured in a fox trap on June 23, 1892, near New London. Bain (1891) stated that it sometimes visits the island.

Northern Bald Eagle. *Haliaeetus leucocephalus washingtonii* (Audubon)

Rare summer resident; formerly bred. Two races are known to have occurred. Tufts (in litt.) writes, "I am quite positive that none has nested there for many years. About ten years ago, the late Ludlow

Jenkins of Marshfield, P.E.I. (he was an Honorary Officer), told me of the last pair of eagles to nest in the Province. They were finally discouraged by having their nest destroyed and otherwise molested by humans. The nest was in the Souris district." Breeding birds would belong to the race *washingtonii*, but the writer knows of no breeding record in recent years. Bald eagles of undetermined subspecies were recorded by Hurst (1947) as having been shot at Marshfield and Murray Harbour. A. F. Calder (MS.) has mounted eight, four of which were immature and four adult females. One of these immature birds was collected at Cavendish on June 3, 1952. In 1952, the writer saw an immature bald eagle near Glencorradale, Kings County, on July 5, and Crosby and the writer observed an adult over St. Peters Bay on August 2. Goodwill (MS.) saw an immature near Murray Harbour village on October 5, 1947. Some of these observed birds may belong to the following race.

Southern Bald Eagle. *Haliaeetus leucocephalus leucocephalus* (Linnaeus)

Non-breeding summer visitant. Broley (1947) recorded the taking in Kings County on June 1, 1941, of a specimen banded by him when it was a nestling at Largo, Florida, on February 8, 1941. He demonstrated that a considerable number of southern birds wander into Canada and northern United States during the summer months. Some of the sight records given under the northern bald eagle may be actually of this race.

Marsh Hawk. *Circus cyaneus hudsonius* (Linnaeus)

Common summer resident; breeds. In 1952, the writer observed it twenty-three times in June, and eighteen times in July, in meadows, fields, and marshes in all parts of the island. A pair appeared to be nesting in a moist meadow near Mount Stewart. This appears to be the commonest summer hawk. MacSwain (1908) stated that it breeds. Bain (1891) asserted that it is present summer and winter, but if it winters it must be rare at that season. Goodwill (MS.) observed one on October 23, 1947, his latest observation. One banded at St. Martins, P.Q., on July 7, 1935, was shot at Murray River, P.E.I., on July 13, 1937 (Cooke, 1941).

American Osprey. *Pandion haliaëtus carolinensis* (Gmelin)

Uncommon summer resident. Dwight (1893) observed it at Tignish and Souris. The writer recorded it in 1952 near Mount Stewart on June 5 (1); East Lake, July 4 (3); Fox Point, Prince County, July 24 (1); Cavendish, July 26 (1); Deroche Pond, August 4 (1). On June 10, some eleven miles west of Souris, two called and circled above the writer in wooded country. However, a search of the surrounding forest revealed no nest. The seasonally latest date is October 8, 1947, when Goodwill (MS.) recorded one near Murray River.

Gyrfalcon. *Falco rusticolus obsoletus* Gmelin

Rare winter visitant or transient. Hurst (1947) recorded a light-phase specimen of the *candicans* type which was shot at Southport in March, 1941. The writer saw a mounted dark-phase specimen in the Prince of Wales College collection. A. F. Calder (MS.) mounted this bird which was taken at Keppoch, Queens County, on May 28, 1905, by Allan MacDonald. MacSwain (1908) recorded one taken near Southport on November 7, 1904.

Duck Hawk. *Falco peregrinus anatum* Bonaparte

Transient. A mounted specimen seen by the writer in the Prince of Wales College collection was shot, according to A. F. Calder, at Tea Hill, near Charlottetown, on September 4, 1950, by William Redden. MacSwain (1908) recorded an immature specimen collected by Frank E. Johnson at Lowther's Point on October 3, 1906. Bain's (1891) mention of its 'home' on the island is far too vague to be acceptable as a breeding record. Goodwill (MS.) observed one in the Murray Harbour area on October 20, 1947.

Eastern Pigeon Hawk. *Falco columbarius columbarius* Linnaeus

Transient and rare summer resident. MacSwain (1908) stated that it has been found to breed but gave no details. Bond and Ross (MS.) observed one at Bedeque on June 13, 1949. Goodwill (MS.) saw one at Murray Harbour on October 12, 1947. The writer observed one on July 13 at Rollo Bay and another on July 23 at Conley Inlet.

Specimens examined:

Mount Albion: 1 post-juv. unsexed; September 1, 1933. R. W. Tufts.

Eastern Sparrow Hawk. *Falco sparverius sparverius* Linnaeus

Uncommon summer resident; breeds. Dwight (1893) did not record it, and MacSwain (1908) considered it rare but stated that it breeds. Bond and Ross (MS.) saw but one, this on June 15, 1949. In 1952, the writer observed it sparingly as follows: Squaw Bay, May 31 (2); Mount Stewart, June 5 (1); Swallow Point, June 25 (1); Glencorradale, July 8 (1); Rollo Bay, July 10 (1); Cascumpeque Point, July 24 (1); Stanhope, July 27 (1); East Point, July 30 (3); and Red Point, July 30 (1).

Specimens examined:

West Cove Head: 1 imm. unsexed; summer, 1938. J. Spurgeon Jenkins.

[**Spruce Grouse.** *Canachites canadensis* (Linnaeus)

Hypothetical. The writer finds no definite information in the literature that would establish the occurrence of this species. No one with whom he talked had ever seen it or suspected that he had. Bain (1891) stated unequivocably that it was present at the time he wrote, and he contrasted its habitat preferences with those of the ruffed grouse. However, he gave no definite source of his information, and there is no assurance that it was reliable. MacSwain (1908) never saw it himself but was told by elderly sportsmen, who professed to know it, that it was not uncommon a few years before MacSwain wrote. He considered it to be extirpated then. Dwight (1893), on the other hand, was told by gunners that it did not inhabit the island.]

Saint Lawrence Ruffed Grouse. *Bonasa umbellus togata* (Linnaeus)

Permanent resident in fluctuating numbers; breeds. In 1952, the writer recorded drumming males on June 1 (1), 3 (4), 9 (1), 12 (2), 13 (1), 23 (1), 25 (1), 30 (1); and July 10 (1). Near St. Charles on June 25 one drummed until almost dark at 8·32 p.m. A.S.T. Broods of young were observed near Hermanville, July 1; Glencorradale, July 5; Harmony Junction, July 8; and Bloomfield, July 21.

Specimen examined:

Hermanville: 1 ad. ♀; June 19, 1952.

European Partridge. *Perdix perdix* (Linnaeus)

Introduced. Now a common permanent resident; breeds. Tufts (1931 and 1939) stated that twelve pairs were introduced on October 27, 1927. Peters (MS.) stated that these were imported from Bohemia. The latter said that an additional thirty-eight pairs were liberated in 1931 and that later six pairs were obtained from Saskatchewan. These increased rapidly until the winter of 1933-34 when weather and snow conditions and predators were said to have caused an estimated 80 per cent kill. The species then increased again, and a first official open season was granted the sportsmen throughout October, 1939. In 1952, the writer recorded it near Bothwell Beach, June 14 (2); Hermanville, June 19 (2), July 1 (2); Swallow Point, June 21 (1); Howe Bay, July 5 (2); Belle River, July 14 (1); Brackley Beach, July 17 (1); Foxley River, July 22 (1); Cascumpeque, July 24 (2); near Montague, July 30 (2). Goodwill (MS.) saw about fifteen young near Souris on August 8, 1948.

Pheasant. *Phasianus colchicus* Linnaeus

Introduced. Now a permanent resident; breeds. According to Hurst (1947) it had been introduced and was becoming 'naturalized' by 1940. Lloyd (1928) quoted Robie W. Tufts as follows: "There were two attempts at introducing the ring-necked pheasant into Prince Edward Island in 1925. In the spring of that year four hens and one cock were liberated at Charlottetown, while at Vernon River, about fourteen miles from Charlottetown, 'a few pairs' were liberated at the same time. During the summer of 1925 three covies were reported near Vernon River. Though there has not been any appreciable increase noted to date (1927), they are still present in small numbers and are frequently reported as seen in the rural districts. It is claimed that the cock pheasant will attack and even kill the domestic cock, and at least one authentic instance of this is reported by J. D. Jenkins of Charlottetown, where a large plymouth rock cock was attacked and killed by a cock ring-necked pheasant." Hurst (op. cit.) mentioned additional numbers introduced in 1945 and 1946. The writer recorded it in 1952 near Hermanville on June 14 (1), 16 (1); near St. Peters, June 20 (2); Swallow Point, June 26 (1); near Souris, July 30 (1).

Lesser Sandhill Crane. *Grus canadensis canadensis* Linnaeus

Casual visitant. Moore (1906) recorded an immature female collected at Alexandra on September 22, 1905. MacSwain (1908) recorded another shot at Earnscliffe on October 25, 1905, described it and gave measurements which indicate that it was of the nominate race.

Virginia Rail. *Rallus limicola limicola* Vieillot

Probably accidental. MacSwain (1908) saw a mounted specimen which was taken at Tignish by W. Earle, and he stated that another was shot by Earle at Belle River which was preserved also.

Sora Rail. *Porzana carolina* Linnaeus

Locally a fairly common summer resident; breeds. MacSwain (1908) recorded a mounted specimen from Tignish and stated that two were collected at Wisener's Mills on October 4, 1906, by Frank E. Johnson. In 1952 the writer noted this rail in fresh-water marshes at Black Pond on

June 14 (1), July 8 (2), August 3 (3); near Brackley Beach, July 17 (2); Schooner Pond, August 2 (1); and at Harmony Junction on June 30. An adult was watched with five downies for some minutes. On various occasions food was passed to these young by the parent. With the aid of a dog on July 22, 1949, a nest with six eggs was found by George Boyer and C. E. Addy at Dunk River.

American Coot. *Fulica americana americana* Gmelin

Rare visitant. MacSwain recorded a Prince Edward Island specimen but gave no details other than that it was mounted and later bought by Calder. Hurst (1947) stated that one was seen at Wilmot in May, 1942, by Douglas J. Heath, and that one was observed on Black Pond in May, 1943, by J. Spurgeon Jenkins. Harold S. Peters (MS.) was with Jenkins at the time and observed it also, stating that this was on May 10. Bain (1891) described the nest of this species but did not state that a nest was ever found on Prince Edward Island.

Piping Plover. *Charadrius melodus melodus* Ord

Fairly common summer resident on the beaches; breeds. The writer observed it in 1952 as follows: Stanhope, June 1 (2), July 27 (11); near Hermanville, June 27 (2); near East Lake, July 4 (1); Little Tignish River, July 16 (2), 20 (1); Conway Inlet, July 23 (2); Dalvay, July 26 (2); near Schooner Pond, July 31 (2). At Stanhope two adults and two downies were observed on July 26, and one adult with young was seen at Howe Bay on August 4.

Specimen examined:

Hermanville (2 miles east): 1 ad. ♀; June 27, 1952

This specimen has a broken pectoral band. Of seven adults observed in the field six had a broken pectoral band. One appeared to be unbroken.

Semipalmated Plover. *Charadrius hiaticula semipalmatus* Bonaparte

Common spring, summer, and autumn transient; breeds rarely. In 1952, the writer observed four on May 31. Southbound migrants appeared at Tignish on July 16 when six were noted. After that it was observed regularly at various localities, largest daily count being fifty-two on August 4 at Howe Bay. Goodwill (MS.) observed it as late as October 20, 1947, when he saw one near Murray Harbour.

Killdeer. *Charadrius vociferus vociferus* Linnaeus

Uncommon summer resident. Not known to breed. Considering that this plover is very rare in Nova Scotia it was surprising to find so relatively many in Prince Edward Island. In 1952 the writer recorded it at Rollo Bay on June 13 (3), 22 (1), July 4 (1); near Hermanville, June 14 (1), 23 (1); Harmony Junction, June 30 (1); 2 miles northeast of Harmony Junction, July 8 (1); MacPherson Creek, July 14 (2); West Point, July 16 (2); North Point, July 18 (3); Little Tignish River, July 18 (1); Tignish River, July 25 (1); Kildare River, July 24 (3); Trout River, July 24 (1). Bond and Ross (MS.) saw one at Port Wood on June 17, 1949. Although Dwight (1893) did not observe it, Bain (1891) implied that it was not rare then. None of the birds observed by the writer behaved as though breeding.

American Golden Plover. *Pluvialis dominica dominica* (Müller)

Transient. Once quite common, it had become rare when MacSwain (1908) wrote. Hurst (1947) quoted Ludlow Jenkins, a reliable observer, in stating that it was not common. Goodwill (MS.) observed twenty-five at the mouth of Murray River on September 11, 1947, and he saw eleven near the entrance to Murray Harbour on September 18, 1947.

Black-bellied Plover. *Squatarola squatarola* Linnaeus

Common spring, late summer, and autumn transient. In spring migration, fifteen were seen by the writer on May 30 at Squaw Bay and similar numbers from May 31 to June 3 near Souris. First autumn transients were noted on July 22 when four were seen at Cavendish Inlet, Prince County. After this it was seen regularly in small numbers until the writer left the field. Bond and Ross (MS.) recorded it on June 14, 1949, when they travelled from Summerside to North Point. Goodwill (MS.) noted it regularly in autumn, 1947, until October 31, shortly after which he left the field.

Ruddy Turnstone. *Arenaria interpres morinella* (Linnaeus)

Spring and fairly common late summer and autumn transient. The writer saw four at Squaw Bay on May 30. Autumn migration was first observed on July 22 when eight were noted at Cavendish Inlet. Between that date and August 5 a total of 241 individuals were counted on beaches and mud flats in various localities. Goodwill (MS.) observed it until October 26, 1947. The writer collected a solitary male near St. Peters on June 21, an unusual date. This bird appeared to be in good health and was first observed in strong flight.

Specimen examined:

St. Peters (5 miles northeast): 1 ad. ♂; June 21, 1952.

American Woodcock. *Philohela minor* (Gmelin)

Fairly common summer resident; breeds. In 1952, the writer recorded it at the head of Fortune River, St. Charles, Glencorradale, Little Miminegash Pond, St. Louis, and Rollo Bay. Peters (MS.) observed singing males in several localities. He was told by J. Spurgeon Jenkins that the woodcock arrives about the first week in April and that it departs in early November. Solman (Aldrich and others, 1952) gives singing ground counts at Fortune, Avondale, French Village, and Conway.

Wilson Snipe. *Capella gallinago delicata* (Ord)

Not uncommon summer resident; breeds. In June and July, 1952, the writer counted a total of forty-two individuals in well distributed localities. "Winnowing" was last heard on July 14 at Squaw Bay. Dwight (1893) talked with several men who had found nests.

[**Long-billed Curlew.** *Numenius americanus* Bechstein

Hypothetical. Vague reference is made to the occurrence of this species by MacSwain (1908) and Hurst (1947). There is a specimen without data in the Prince of Wales College collection, but no one with whom the writer talked could say from where it was taken.]

Hudsonian Curlew. *Numenius phaeopus hudsonicus* Latham

Locally a common late summer and early autumn transient. MacSwain (1908) called it a not uncommon summer visitor, and Hurst (1947) believed that it probably was increasing between 1920 and 1924. In 1952, the writer's first observation was on July 16 when six were seen near the mouth of Little Tignish River. On thirteen dates between then and August 2, a total of 547 was recorded. On July 31 many points along the eastern part of the north shore were searched for this species, and a total of 256 individuals was located at Campbell Cove, Long Point, Cable Head, and Beaver Point. On several occasions this curlew fed on the fruit of crowberry, *Empetrum nigrum*, and it was observed once eating blueberries. In some grassy fields it appeared to be catching and eating orthopterous insects.

Eskimo Curlew. *Numenius borealis* (Forster)

Formerly a common transient. Now extinct or nearly so. According to MacSwain (1908) this was once the common curlew on the island. MacKay (1896) recorded an observation made by William Everett of a flock of fifty alighting on a field which was being ploughed at New London on September 1, 1872. Fifteen of these were shot by Everett. A. F. Calder told the writer that there was a specimen in the Prince of Wales College collection which was taken locally in 1904 and was mounted by Professor Earle. The writer did not see this specimen. Calder (oral) shot specimens about 1890.

[**Upland Plover.** *Bartramia longicauda* (Bechstein)

Hypothetical. Bain (1891) wrote of great numbers in September and October. Undoubtedly some other bird was mistaken for this species. MacSwain (1908), significantly, did not mention its occurrence. Hurst's (1947) statement that he saw a small flock in 1938 is probably based on a misidentification of some other species. The writer knows of no certain evidence of its occurrence at any time.]

Spotted Sandpiper. *Actitis macularia* (Linnaeus)

Common summer resident; breeds. In June and July, 1952, the writer recorded sixty-two adults in well distributed localities throughout the island. Flightless young were seen on July 19 near Alberton. Dwight (1893) recorded a nest at Tignish. Goodwill's (MS.) latest 1947 record was of one on October 4 near Murray Harbour village.

Eastern Solitary Sandpiper. *Tringa solitaria solitaria* Wilson

Uncommon late summer and autumn transient. Hurst (1947) stated that it is a not uncommon autumn migrant. The writer observed four at Black Pond on July 30, 1952. Peters (MS.) recorded one at the same place on July 21, 1943. Goodwill (MS.) observed it several times in August and September, his seasonally latest date being two on October 12, 1947.

[**Willet.** *Catoptrophorus semipalmatus* (Gmelin)

Hypothetical. Bain (1891) asserted that it is not uncommon, and MacSwain (1908) called it rare. Hurst (1947) placed it in his list of 'excluded species'. There seems to be no definite record of its occurrence, although it breeds in parts of Nova Scotia and may yet be found in Prince Edward Island.]

Greater Yellow-legs. *Totanus melanoleucus* (Gmelin)

Common spring, late summer, and autumn transient; uncommon summer resident not definitely known to breed. Peters (MS.) saw ten on May 14, 1941; one on May 9, 1942; fifteen on May 12, 1944. On June 13, 1952, the writer observed one at the head of Fortune River which 'scolded' repeatedly before it flushed. Apparently the same bird was seen there on June 15. Another individual seen by Crosby and the writer on July 15, 1952, at Miscouche Point, west of Summerside, was flushed from a marsh at the edge of a small muskeg. It circled low over us for several minutes, calling repeatedly, in a manner that suggested breeding. However, the writer once saw an individual behave similarly in late summer in northern Ohio, south of its breeding grounds. Bain (1891) believed that it nested on the island but gave no details. Hurst (1947) and MacSwain (1908) spoke of it only as a migrant. The writer saw singles on July 3 at St. Peters, and on July 6 at Howe Bay. After July 14 it became common and was seen daily. Goodwill (MS.) in 1947 observed small numbers regularly through September and until October 25.

Lesser Yellow-legs. *Totanus flavipes* (Gmelin)

Transient; common in late summer and early autumn. The writer first observed it on July 14 after which, like the greater yellow-legs, it became common and was noted daily. Goodwill (MS.), in 1947, observed it on four September dates, September 21 being the latest.

American Knot. *Calidris canutus rufa* (Wilson)

Uncommon transient. MacSwain (1908) recorded a specimen, mounted by Calder, which was shot at Alexandra on September 24, 1905. Considering the writer's observations in 1952, it seems strange that it has not been more frequently recorded previously. The writer saw eleven at Little Tignish River mouth on July 16; five at Tignish on July 20; twelve at Cavendish Inlet on July 22, and five there on the two following days; two at Conway Inlet on July 23; four at Cascumpeque Point, July 24; fifteen at Enmore River mouth on July 24; and thirteen at Panmure Island on July 30.

Purple Sandpiper. *Erolia maritima* (Brünnich)

Late autumn transient and winter resident. MacSwain (1908) saw a mounted specimen at A. F. Calder's which was collected on St. Peters Island on February 6, 1901.

Pectoral Sandpiper. *Erolia melanotos* (Vieillot)

Transient. MacSwain (1908) examined four in the Charlottetown market on September 27, 1907. He had not observed it previously. It seems surprising that there are not more records.

White-rumped Sandpiper. *Erolia fuscicollis* (Vieillot)

Spring and autumn transient. In 1952, the writer observed it first on July 26 when three were seen at Stanhope Beach. Three, perhaps the same, were noted there on July 27. The writer also observed it on Panmure Island, July 30 (2); near Schooner Pond, July 31 (1); Howe Bay, August 4 (6); St. Peters, August 6 (5). MacSwain (1908) said that it also is a spring transient.

Least Sandpiper. *Erolia minutilla* (Vieillot)

Very common late summer and autumn transient. The writer first observed it on July 4, near East Lake, when six were recorded. After July 14 it was observed daily in flocks containing as many as forty individuals.

Red-backed Sandpiper. *Erolia alpina* (Linnaeus)

Transient. A note by Taverner in the files of the National Museum states that this species was reported a September migrant by one Mr. Kobbe in a letter written after 1910. The writer is unable to find this letter in the files now. Goodwill (MS.) carefully observed two at Sable Point, at the entrance to Murray Harbour, on October 20, 1947.

Eastern Dowitcher. *Limnodromus griseus griseus* (Gmelin)

Not uncommon late summer and autumn transient. It seems surprising that neither Bain (1891) nor MacSwain (1908) recorded this species. Hurst (1947) recorded one taken in 1920, and he stated that T. W. Stewart saw about a score at Stanhope on July 19, 1936. In 1952, the writer recorded it at De Sable River, July 15 (28); Tignish, July 16 (7), 18 (7), 25 (7); Dock River, July 16 (7); Cavendish Inlet, July 22 (13), 23 (4), 24 (7); Enmore River, July 24 (6); Cavendish, July 26 (7); Dalvay, July 26 (11); Stanhope, July 27 (25); Howe Bay, August 4 (30); Souris, August 5 (11). Goodwill (MS.) observed small numbers in August and until September 5, 1948. Opportunities to collect specimens were few because of the proximity of densely-peopled summer resorts or villages. However, a good series from nearby Nova Scotia is referable to the nominate race, and there is no reason to doubt that Prince Edward Island migrants are similar.

Semipalmated Sandpiper. *Ereunetes pusillus* (Linnaeus)

Common spring, late summer, and autumn transient; locally abundant in autumn. The writer's only spring observation was of about sixty on June 1, 1952, at Stanhope Beach. First southbound migrants were noted on July 16 when two were seen at West Point. It became common shortly later, and on July 26, 210 were counted. Goodwill (MS.) observed it regularly also in the same season, and through September; his latest date was October 15, 1947.

[**Buff-breasted Sandpiper.** *Tryngites subruficollis* (Vieillot)

Hypothetical. Chamberlain (1887) stated, on the authority of Tileston (presumably Frank L. Tileston), that one was taken on Prince Edward Island. He gave no details.]

Hudsonian Godwit. *Limosa haemastica* (Linnaeus)

Uncommon late summer transient. MacSwain (1908) commented that this species had become very rare and that he had seen only two. He recorded a specimen, however, from Alberton which was mounted by Calder. In 1952, the writer observed this fine shorebird at Cavendish Inlet, Prince County, where twenty-four were present on July 22, twenty-two on the following day, and thirty on July 24. At the mouth of Little Tignish River one was recorded on July 25. Two were seen at Stanhope on July 26 and nine there on July 27.

Sanderling. *Crocethia alba* (Pallas)

Common late summer and autumn transient. The first southbound migrant was observed at Cavendish Inlet on July 22. It was later observed in various localities on July 26 (28), 27 (45), 29 (12), 30 (2), 31 (8); August 2 (18), 4 (40), 5 (25). Bent (1927) gave October 30 as a latest autumn date. It was observed by Goodwill (MS.) until October 27.

[**Red Phalarope.** *Phalaropus fulicarius* (Linnaeus)

Hypothetical. Hurst (1947) included this species apparently only because it is known to migrate through other parts of the Maritimes. Bent (1927) gave November 20 as a late autumn migration date at North River. It seems probable that this species may occur in Prince Edward Island, but more definite information is needed to confirm this.]

Northern Phalarope. *Lobipes lobatus* (Linnaeus)

Transient. Hurst (1947) included it only on probability. On August 17, 1948, Goodwill (MS.) observed one at very close range as it rested on the water about 2½ miles south of Souris Head. He noted the eye patch and needle-like black bill. On September 3, 1948, he observed one under ideal conditions, in the water just below his position on a wharf at Souris.

[**Parasitic Jaeger.** *Stercorarius parasiticus* (Linnaeus)

Hypothetical. MacSwain (1908) stated that he had seen a specimen but gave no details concerning it or how he distinguished it from other jaegers that might occur.]

Glaucous Gull. *Larus hyperboreus hyperboreus* Gunnerus

Transient and probable winter resident. MacSwain (1908) often saw it in autumn, but as he did not record the Iceland and kumlien gull he probably mistook some individuals of those forms for glaucous gulls. Tufts, who knows the bird well, stated (*in* Hurst, 1947) that it is a not uncommon winter resident.

Iceland Gull. *Larus leucopterus leucopterus* Vieillot

Spring and autumn transient and winter resident. Tufts, who has had long field experience with the white-winged gulls in the Maritimes, stated (in Hurst, 1947) that it is a winter bird. Peters (MS.) observed four near Borden on May 12, 1939, four there on May 9, 1943, and one at Summerside on May 10, 1946. Goodwill (MS.) observed at least three adults off West Point on November 2, 1951.

Kumlien Gull. *Larus leucopterus kumlieni* Brewster

Transient and not uncommon winter resident. One was taken at Covehead on October 7, 1905, and was examined by MacSwain (1908) who stated that it had been mounted and sent to Truro, Nova Scotia. Tufts (Hurst, 1947) stated that it is a not uncommon winter resident. Bent (1921) gave October 7 as an autumn migration date which perhaps was based on MacSwain (op. cit.)

Great Black-backed Gull. *Larus marinus* Linnaeus

Common to very common permanent resident; no definite breeding record. There can be little doubt that this conspicuous gull has increased numerically on Prince Edward Island in recent years. Considering its numbers now, it seems amazing that Dwight (1893) did not observe it at all. Bain (1891) called it a winter bird, and MacSwain (1908) said that it was quite common in spring and autumn. Even Hurst (1947) referred to it as a common winter visitor but said nothing of its occurrence at other seasons except to state that he observed it on April 6, 1934. Hurst's list, however, was mainly a compilation from other sources, and it seems certain that it must have been common in summer when he wrote. Dwight, however, would not have missed it had it been similarly common during his visit in 1892. In 1952, the writer found it common locally mainly along the coasts, and it was noted each day spent on the coast. Largest number recorded in a day was approximately 450 (July 25 in the Tignish area); twenty-five or more a day were recorded on twenty-six dates. Goodwill (MS.) also recorded it regularly in summer and autumn. Bond and Ross (MS.) noted it on five of six days they spent on the island in June, 1949. The writer found no evidence of nesting. A large part of the summer population is made up of sub-adults. Austin (1932) recorded that a specimen, banded when immature at Sandy Island, Labrador, on August 9, 1928, was found dead in a herring net at Lennox Island, P.E.I., on May 1, 1949.

Herring Gull. *Larus argentatus smithsonianus* Coues

Very common permanent resident, but not known to breed. The writer observed it daily throughout the island wherever suitable habitat existed, and it appeared to be the commonest gull. Goodwill (MS.) observed it regularly during his extensive field work. He recorded 951 on September 17, 1947, in the Murray Harbour area, and 906 on September 20 in the same area. Bain (1885 and 1891) described its winter status.

Ring-billed Gull. *Larus delawarensis* Ord

Uncommon visitant. Not known to breed. Heretofore the only record of this species appears to be that of MacSwain (1908) who stated that he had seen one but gave no details. In 1952, on June 14, the writer found two at rest in a large flock of herring and great black-backed gulls at North Lake. It was not observed again until July 15 when a year-old bird was observed at Indian Point. In Summerside Harbour three were seen on July 16, one on July 17, ten on July 18, and thirteen on July 26. At Brackley Beach three were seen on July 17; near Cavendish Inlet, four on July 24; near Schooner Pond, one on August 2; and near Souris, three on August 5. Peters (MS.) observed it in unstated numbers in northeastern Prince Edward Island on May 12, 1944, and he noted the species also on May 10, 1946. Goodwill (MS.) saw an immature bird near Souris West on June 20, 1948.

Bonaparte Gull. *Larus philadelphia* (Ord)

Common spring and autumn transient; uncommon non-breeding summer resident. The writer recorded it on May 30 (6), 31 (7); June 1 (6), 3 (2), and on June 23 a flock of twenty-seven, mostly immature, was seen on Panmure Island. After July 15 it was seen regularly, and by early August as many as 150 were noted in a day (August 4 at Howe Bay) and 110 on August 5 at Souris. Goodwill (MS.) observed it similarly, but his seasonally later observations indicate that it is commonest in late August and early September. He saw about 450 on August 29, 1948, west of Souris, and 300 on September 8 on Rollo Bay. Bain (1891) stated that it breeds in great numbers with terns on outer reefs and sand banks, which statement, of course, is erroneous because this species nests in trees. Bond and Ross (MS.) saw the species on June 15, 16, and 18; none of these birds were in full adult breeding plumage. Peters (MS.) saw sixteen on May 11, 1939, and on May 11, 1943, about twenty.

[**Ivory Gull.** *Pagophila eburnea* (Phipps)

Hypothetical. Mentioned as being accidental and doubtful by Hurst (1947). Macready (1916) referred to it as a quotation from MacSwain as being "rarer than No. 27", but it is not included in MacSwain's (1908) list.]

Atlantic Kittiwake. *Rissa tridactyla tridactyla* (Linnaeus)

Uncommon autumn visitant. Bain (1885) wrote vaguely of its occurrence in winter, and MacSwain (1908) referred to it as being common in summer which is contrary to the observations of others. Hurst (1947) was informed by Tufts that it is an uncommon autumn visitor. Goodwill (MS.) observed an immature bird on October 27, 1947, near Murray Harbour North. He was able to observe all the diagnositic markings, and there cannot be the slightest doubt that he saw an immature of this species.

Common Tern. *Sterna hirundo hirundo* (Linnaeus)

Very common summer resident; breeds. The writer visited a breeding colony, roughly estimated at about 400 adults, at Conway Inlet, Prince County, on July 23, 1952. Some nests contained from one to three eggs, and about 100 young were running about at that time. We observed it breeding near Charlottetown also, in small numbers, as also did Goodwill (MS.). He visited a small breeding colony on June 20, 1948, in the Souris area at Lobster Point.

Arctic Tern. *Sterna paradisaea* Pontoppidan

Uncommon summer resident. The writer observed it only a few times in early June, late July, and early August. There is no definite evidence of breeding, although two observed over a beach near Schooner Pond on August 2, 1952, behaved as though they might have had a nest or young in the vicinity. The higher pitched voice of this species is one of the best means of distinguishing it from the very similar common tern.

Specimen examined:

Schooner Pond: 1 ad. ♀; August 2, 1952.

Caspian Tern. *Hydroprogne caspia* (Pallas)

Uncommon visitant. The only previous definite record is of one taken at Tracadie Bay on May 13, 1905. The writer observed two adults on a sand bar near Conway Inlet on July 23, 1952. They remained in the vicinity for three hours or more. Crosby and the writer saw another later that day at North Point and one at Stanhope on July 27.

Black Tern. *Chlidonias niger surinamensis* (Gmelin)

Accidental. A young male collected at Tignish on September 13, 1887, was recorded by Hitchcock (1892).

[**Atlantic Murre.** *Uria aalge aalge* (Pontoppidan)

Hypothetical. MacSwain's (1908) reference to this species is vague. Hurst (1947) stated that one was taken in a muskrat trap in April, 1923, which seems strange, and that another was picked up wounded. The writer saw two mounted Brünnich murres in the Prince of Wales College collection which had been misidentified as Atlantic murres. The recorded specimens apparently were not examined by a competent authority, and it seems best to place this species in the hypothetical list until a specimen is available. The species should occur in Prince Edward Island waters.]

Brünnich Murre. *Uria lomvia lomvia* (Linnaeus)

Transient and winter resident. It is surprising that this species has not been recorded previously. The writer examined two specimens in winter plumage in the Prince of Wales College collection which had been misidentified as Atlantic murres. Calder (oral) mounted them and assured me that they were taken locally. This species is probably a fairly common transient or winter resident along the coasts.

Dovekie. *Plautus alle alle* (Linnaeus)

Transient and winter resident. Hurst (1947) stated that it is a late autumn and winter visitant and that during a storm on October 26, 1930, many were blown inland and perished. Bain (1891) and MacSwain (1908) mention its occurrence also. Goodwill (MS.) saw one between Summerside, P.E.I., and Miramichi Bay, New Brunswick, on November 2, 1951.

Black Guillemot. *Cepphus grylle atlantis* Salomonsen

Not uncommon summer resident; breeds; probably winters. In 1952 the writer observed it in small numbers near Souris, Chepstew Point, McKinnon Point, Cape Bear, Greenhill, near Campbellton, Cape Tryon, North Point, Cavendish, East Point, Durrell Point. It was also found breeding at Cape Bear and Greenhill, near North Point, and at Durrell Point.

Eastern Mourning Dove. *Zenaidura macroura carolinensis* (Linnaeus)

Uncommon autumn visitant. MacSwain (1908) recorded one taken at Alexandra on September 22, 1905, which was mounted by Calder. Hurst (1947) recorded one also from Alexandra in 1910, one found dead at Lake Verde in 1932, and a sight record in 1940 with no further data. Both Sterns and Jenkins told the writer in 1952 that it had occurred more frequently in recent years in the autumn. Sterns has seen one or two each autumn between 1949 and 1952. He saw one at Souris on November 19, 1943, and another at Black Pond on September 22, 1949.

Passenger Pigeon. *Ectopistes migratorius* (Linnaeus)

Extinct. Jacques Cartier, in 1534, observed many 'stockdoves'. According to MacSwain (1908) it once occurred in large flocks, and the last seen were in 1857. Hurst (1947) quotes MacSwain that the last were seen in 1875, but presumably he erroneously copied the date. Earlier Bain (1891) referred to great numbers at the early settlement of the country and said that, when he wrote, only a rare straggler was to be seen on Prince Edward Island. This implies that stragglers occurred after 1857.

However, in Sutherland's (1861) time they were rare so he said 'wild pigeons' only occasionally visited the grain fields. If any preserved Prince Edward Island specimen of this extinct species is still extant, it should be recorded.

Yellow-billed Cuckoo. *Coccyzus americanus americanus* (Linnaeus)

Very rare or accidental. MacSwain (1908) reported that one was shot at Brackley Point and that it was mounted and was in the museum of the Natural History Society, Charlottetown, at the time he wrote.

Black-billed Cuckoo. *Coccyzus erythropthalmus* (Wilson)

Uncommon summer resident. Dwight (1893) collected one at Tignish in 1892, his only record. Bond and Ross (MS.) saw one near Nail Pond on June 14, 1949. In 1952 the writer observed it as follows: Swallow Point, June 26 (2); Little Tignish River, July 18 (2); Tignish, July 20 (1); Inverness, July 19 (1); Harmony, Prince County, July 19 (2); O'Leary, July 21 (1); Little Miminegash Pond, July 21 (1); Freeland, July 23 (1), 24 (1); Kildare River bridge, July 24 (1); near North Point, July 25 (1). It appeared to be definitely more common in Prince County than in north-eastern Kings County, for all but two of the observations were made in Prince County in ten days.

[**Eastern Screech Owl.** *Otus asio naevius* (Gmelin)

Hypothetical. Although reference is made in several publications, including the A.O.U. Check-list (1931), to the accidental occurrence of this owl, the writer is aware of nothing more definite concerning its status than MacSwain's (1908) vague statement that he saw only one.]

Great Horned Owl. *Bubo virginianus virginianus* (Gmelin)

Permanent resident; breeds. The writer flushed one at about 100 yards on June 9, 1952, about ten miles west of Souris, our only observation. Goodwill (MS.) saw one on July 18, 1948, 3 miles north of Souris. A nestling in the National Museum attests to the breeding of the species. The writer examined the stomach of an adult taken near Charlottetown on March 7, 1938, which contained bones and fur of a varying hare, *Lepus americanus*, and three blades of grass averaging 65 mm. in length.

Specimens examined:

Prince Edward Island (no further locality): 2 ad. ♂, 2 ad. ♀, 1 nestling; June, 1934; J. Spurgeon Jenkins.
Charlottetown: 1 ad. ♂; March 7, 1938.

These specimens perhaps tend very slightly toward *heterocnemis* but are decidedly closer to the nominate race.

Snowy Owl. *Nyctea scandiaca* (Linnaeus)

Irregular winter resident; sometimes common. MacSwain (1908) said that many appeared in the winter of 1905-6, Hurst (1947) noted an incursion in winter 1926-7, and Peters (MS.) stated that a big incursion took place in the winter of 1941-2. Peters observed one at Annandale on October 23, 1941, and another near Souris on May 11, 1946, a late spring record. The writer examined five stomachs from Snowy Owls taken in the Charlottetown area, March 7 to 9, 1938. One contained three feathers from a European partridge; the second contained a whole European partridge (with one leg still in one piece from foot to femur) and two grains of sand; the third contained two meadow mice, *Microtus pensylvanicus*, one snow bunting, *Plectrophenax nivalis*, the latter intact; the fourth had three feathers from a passerine bird, one small seed, and a piece of wood 13 by 6 by 4 mm.; and the fifth contained thirty-nine grains of coarse sand.

Specimens examined.

Charlottetown area: 3 ♂, 2 ♀; March 7-9, 1938.

American Hawk Owl. *Surnia ulula caparoch* (Müller)

Rare winter visitant. MacSwain (1908) stated that there were two mounted specimens but did not give the localities. One locally-taken mounted specimen in the Prince of Wales College collection, which was examined by the writer, might have been one of these.

Northern Barred Owl. *Strix varia varia* Barton

Permanent resident. MacSwain (1908) calls this and the great horned owl the commonest owls. The writer did not personally observe it but saw a locally-taken mounted specimen without further data.

[**Great Gray Owl.** *Strix nebulosa* Forster

Hypothetical. References to this species by Hurst (1947) and Macready (1916) are based on Bain's (1891) statement that it is a "winter bird of the lonely forest."]

Long-eared Owl. *Asio otus wilsonianus* (Lesson)

Apparently uncommon. MacSwain (1908) reported one on October 14, 1904. A mounted specimen in the Prince of Wales College collection was seen by the writer, and this was said to have been taken locally. Crosby saw one on June 5, 1952, some two miles east of Mount Stewart.

Short-eared Owl. *Asio flammeus flammeus* (Pontoppidan)

Summer resident. Said by MacSwain (1908) to be commoner than the preceding species; a summer resident according to Hurst (1947). Peters (MS.) observed one at Wisner's Mill Pond on May 13, 1944.

Richardson Owl. *Aegolius funereus richardsoni* (Bonaparte)

According to MacSwain (1908) one was shot in a barn at Alexandra and taken to Calder to be mounted on December 26, 1905.

Saw-whet Owl. *Aegolius acadicus acadicus* (Gmelin)

MacSwain (1908) called it a not rare resident and said that several were collected near Pownal in 1904. Hurst (1947) stated that one was observed at Souris in the winter of 1935-6 by J. Frank Sterns and that another was taken at Brackley Beach on February 5, 1941. Calder assured the writer that the specimens in Prince of Wales College were mounted by him and were taken locally. He says that he mounts a few each winter.

Eastern Nighthawk. *Chordeiles minor minor* (Forster)

Fairly common summer resident; breeds. The writer observed it in all three counties but saw no more than four on any one date. MacSwain (1908) found two eggs on June 15, 1905.

Specimens examined:

St. Charles (4 miles north): 1 ad. ♂; June 23, 1952.
New Zealand: 1 ad. ♂, 1 ad. ♀; July 4, 1952.
Selkirk: 1 ad. ♂; July 7, 1952.

Chimney Swift. *Chaetura pelagica* (Linnaeus)

Uncommon summer resident. The writer observed it only at Hermanville, June 17 (1); East Point, June 22 (2); Bonshaw, July 15 (1); Richmond, July 19 (2); Harmony, Prince Co., July 19 (1); O'Leary, July 21 (1); Crapaud, August 6 (1). Dwight (1893) also found it rather rare. Peters (MS.) recorded it on the island between June 7 and 10, 1940. Goodwill (MS.) saw one or two near Souris on June 23, July 1, July 9, and August 10, 1948. Calder (MS.) collected one at Hunter River on July 8, 1930.

Ruby-throated Hummingbird. *Archilochus colubris* (Linnaeus)

Summer resident; breeds. The writer observed single birds near Souris, June 12; Hermanville, June 17; Summerside, July 15; Freeland, July 19; Alberton, July 20; and Haliburton, July 21. Klugh (1921) recorded a nest at Malpeque.

Eastern Belted Kingfisher. *Megaceryle alcyon alcyon* (Linnaeus)

Fairly common summer resident; breeds. The writer observed it in most suitable localities visited and found it nesting near Cavendish. First flying young were seen on July 14 at Orwell River. Goodwill (MS.) observed it until October 14, 1950.

Northern Flicker. *Colaptes auratus luteus* Bangs

Common summer resident throughout the island; breeds. Observed by the writer almost daily, but no more than ten were seen on any one date. A nest with eggs was found on June 1 near Stanhope.

Specimens examined:

Kings County: 1 ad. ♂, 1 juv. ♂; June 30-July 2, 1952.

The wing of the adult measures 158 mm.

Northern Pileated Woodpecker. *Dendrocopus pileatus abieticola* (Bangs)

Apparently extirpated. Even in Bain's (1891) time, this woodpecker of the large forest was rarely seen. Dwight (1893) was informed that it formerly was common, but he found no new evidence of its occurrence. He was shown a mounted specimen, perhaps the same referred to by MacSwain (1908). The writer saw a mounted specimen without data in the collection at Prince of Wales College.

Yellow-bellied Sapsucker. *Sphyrapicus varius varius* (Linnaeus)

Rare summer resident; breeds. Both Dwight (1893) and MacSwain (1908) agree that this woodpecker is rare. The writer collected an adult female on July 5 in birch-maple forest near Glencorradale. On July 8, three adults were found in one of the few good stands of hardwood that remain, north of Harmony Junction, and on July 9 Crosby found a nest there. Sterns (oral) has seen it a few times.

Specimen examined:

Glencorradale: 1 ad. ♀; July 5, 1952.

Eastern Hairy Woodpecker. *Dendrocopos villosus villosus* (Linnaeus)

Fairly common permanent resident; breeds. The writer recorded twenty-nine individuals between June 9 and August 2, 1952, in scattered localities throughout the area. MacSwain (1908) stated that it winters and breeds.

Specimens examined:

Kings County: 3 ad. ♂, 1 ad. ♀, 1 juv. unsexed; June 9-July 8, 1952.

Wings of 3 males measure 121·5 to 127·1 mm. (av. 123·5); wing of one female, 123·0. They show no tendency toward the well-marked Newfoundland race *terraenovae*.

Northern Downy Woodpecker. *Dendrocopos pubescens medianus* (Swainson)

Permanent resident; breeds. The writer observed only fourteen adults in both the eastern and western parts of the island. A nest containing young was seen on July 8 near Harmony Junction. On the same date first flying young were observed in the same locality.

Specimen examined:

Harmony Junction: 1 ad. ♂; July 8, 1952.

Arctic Three-toed Woodpecker. *Picoides arcticus* (Swainson)

Uncommon permanent resident. The writer observed it only in white spruce forest near St. Charles and Hermanville. Singles were noted on June 10, 13, 25, and July 1, and on August 1st two were seen. MacSwain (1908) called it a rare winter visitor.

Specimen examined:

Hermanville: 1 ad. ♂; August 1, 1952.

[**American Three-toed Woodpecker.** *Picoides tridactylus* (Linnaeus)

Hypothetical. The only evidence of the occurrence of this woodpecker is MacSwain's (1908) statement that it is rarer even than the Arctic three-toed woodpecker.]

Eastern Kingbird. *Tyrannus tyrannus* (Linnaeus)

Rather common summer resident. Observed almost daily in all three counties. Highest daily count was seventeen on July 21. Goodwill's (MS.) latest date in 1947 was one on September 24 at Guernsey Cove.

Specimen examined:

Hermanville: 1 ad. ♂; June 19, 1952.

[**Eastern Phoebe.** *Sayornis phoebe* (Latham)

Hypothetical. Bain (1891), MacSwain (1908), and Hurst (1947) refer to the occurrence of this flycatcher. In view of its rareness in Nova Scotia and eastern New Brunswick and the fact that no specimen has been examined by a competent authority, it seems best to regard its presence on Prince Edward Island as hypothetical.]

Yellow-bellied Flycatcher. *Empidonax flaviventris* (Baird and Baird)

Common summer resident in damp woods and tall shrubbery throughout the island. In 1952 observations were as follows: June 1 (1), 3 (4), 5 (2), 7 (2), 9 (8), 10 (2), 11 (5), 12 (6), 13 (4), 14 (2), 17 (2), 18 (2), 19 (3), 28 (1), 30 (3); July 3 (1), 5 (2), 7 (3), 8 (3), 9 (3), 10 (2), 19 (1), 21 (4), 25 (2), 31 (1). Bond and Ross (MS.) observed it on four of the six days they spent on the island. Bain (1891) did not record it; MacSwain (1908) saw only one; Hurst (1947) called it very rare; and Dwight (1893) was surprised at the scarcity he found, having observed small numbers only at Tignish.

Specimens examined:

Souris: 2 adult ♂; June 11, 1952.

[**Acadian Flycatcher.** *Empidonax virescens* (Vieillot)

Erroneously recorded. Hurst's (1947) comments that it was plentiful in 1936 and that it occurred in 1936, 1937, and 1939 at Pownal, are obviously based on misidentifications of the yellow-bellied or the alder flycatcher.]

Alder Flycatcher. *Empidonax traillii traillii* (Audubon)

Not uncommon summer resident. The writer observed it, mostly in tall shrubbery, throughout the island as follows: June 1 (1), 3 (2), 5 (7), 6 (6), 9 (2), 10 (3), 13 (2), 14 (3), 17 (2), 21 (1), 25 (2), 26 (3), 27 (2); July 1 (2), 2 (1), 3 (1), 7 (1), 14 (1), 15 (1), 18 (2), 19 (3), 22 (2), 23 (2), 24 (3), 25 (2); August 1 (1), 4 (3). Bond and Ross (MS.) noted it on five of six observation days in 1949. MacSwain (1908) stated that it was very rarely seen, and Dwight (1893) found it only at Tignish where he saw a few.

Specimens examined:

Mount Stewart: 1 ad. ♂; June 5, 1952.
St. Peters: 1 ad. ♀; June 25, 1952.

Least Flycatcher. *Empidonax minimus* (Baird and Baird)

Uncommon summer resident. Only three were observed by the writer, singles at Rollo Bay, east of Souris, on June 13; Lower Montague, June 23; and near Campbellton, July 21. Dwight (1893) noted one near Souris in the early summer of 1892. Klugh (1921) stated that one nested at Malpeque, presumably in 1920.

Eastern Wood Pewee. *Contopus virens* (Linnaeus)

Local summer resident; breeds. The writer found it scarce in the extreme northeastern part where only two were seen (near Harmony Junction on July 8). It was commoner in the western end where on July 21 three were noted at O'Leary, two at Haliburton, two at Burton, and one at St. Louis. First observed on June 1 at Charlottetown. Goodwill (MS.) saw one at Souris on September 5, 1948. MacSwain (1908) stated that it breeds.

Specimen examined:

Harmony Junction : 1 ad. ♂; July 8, 1952.

Olive-sided Flycatcher. *Nuttallornis borealis* (Swainson)

Not uncommon summer resident throughout the island. MacSwain (1908) stated that it breeds. The writer observed it at well-scattered localities as follows: June 5 (2), 6 (2), 9 (1), 11 (1), 12 (2), 13 (3), 14 (4), 17 (1), 18 (1), 19 (2), 21 (1), 23 (2), 25 (1), 28 (1); July 2 (2), 19 (1), 20 (1), 21 (1), 22 (1), 24 (1), 25 (1), 28 (1); August 1 (3), 2 (2), 4 (2), 5 (1).

Specimens examined:

Kings County: 1 ad. ♂, 1 ad. ♀; June 12–August 1, 1952.

Prairie Horned Lark. *Eremophila alpestris praticola* (Henshaw)

Fairly common summer resident; breeds. Apparently this race has not long inhabited the island. Bain (1891) and MacSwain (1908) refer to migrant horned larks in spring and autumn which presumably are *Eremophila alpestris alpestris* (Linnaeus) although the writer has been able to examine no migrant specimens. Significantly, Dwight (1893) observed no horned larks in the breeding season in 1892. Hurst (1947) reported that the prairie horned lark was becoming more common and that it nests. Apparently McManus (1936) was first to record this race: on June 24, 1935, he saw one at Alberton, and three there on the following day. On the road to Cape Kildare he reported three more on June 26. In 1952, the writer found it in treeless areas throughout the island as follows: May 31 (6), June 1 (6), 4 (3), 7 (1), 8 (2), 9 (1), 10 (3), 13 (1), 14 (19), 17 (5), 19 (4), 20 (18), 23 (3), 25 (2), 26 (4), 27 (4), 28 (2), 30 (4); July 3 (2), 14 (6), 15 (2), 16 (5), 17 (1), 18 (6), 19 (7), 20 (4), 21 (9), 23 (8), 24 (9), 25 (11), 26 (6), 28 (4), 30 (2), 31 (21). A female taken on June 26 had an incubation patch.

Specimens examined:

Kings County: 2 ad. ♂, 4 ad. ♀; June 20-27, 1952.

[**Northern Horned Lark.** *Eremophila alpestris alpestris* (Linnaeus)

Hypothetical. Transients reported by Bain (1891) and MacSwain (1908) before the prairie horned lark invaded the island almost certainly were this race. It probably is not uncommon as a transient and perhaps a winter resident, but the writer has examined no specimens of the transient and winter population.]

Tree Swallow. *Iridoprocne bicolor* (Vieillot)

Common summer resident throughout the island; breeds.

Bank Swallow. *Riparia riparia riparia* (Linnaeus)

Abundant summer resident; breeds. The low cliffs that characterize so much of the shore provide excellent nesting sites for this swallow. Many large colonies were observed. Dwight (1893) too was impressed by the numbers he found.

Specimen examined:

St. Peters: 1 ad. ♀; June 21, 1952.

Barn Swallow. *Hirundo rustica erythrogaster* Boddaert

Very common summer resident; breeds. Observed by the writer daily in 1952 in all parts of the island visited. Goodwill's (MS.) latest 1947 record was September 27.

Eastern Cliff Swallow. *Petrochelidon pyrrhonota pyrrhonota* (Vieillot)

Uncommon summer resident; breeds. Although the writer recorded this species on twenty days and in well scattered localities throughout the island, ten was the maximum number seen in any one day (July 23). First flying young were seen on July 23. A small colony of four nests at Rollo Bay was broken up by English sparrows. MacSwain (1908) considered it less common after the advent of the English sparrow.

Purple Martin. *Progne subis subis* (Linnaeus)

Rare summer visitant. Hurst's (1947) assertion that it was a common summer resident, becoming rarer, is probably best disregarded. The writer was told by both J. Frank Sterns and Anstruther Caldwell that this species had been observed at Port Borden. Robie W. Tufts writes (in litt.) as follows, "I have a good sight record of a male purple martin at Borden, P.E.I., on June 28, 1929. Was attracted by its well-known gurgling notes as it flew about overhead."

Newfoundland Canada Jay. *Perisoreus canadensis sanfordi* Oberholser

Uncommon permanent resident; breeds. MacSwain (1908) and Hurst (1947) regarded it as rare but stated that it formerly was common. It was not recorded by Dwight (1893), however. In 1952, the writer found this jay in a few more heavily wooded parts of the island. Most observations were near Hermanville, and probably the same individuals were observed on different dates there as follows: June 13 (2 adults and 2 young, latter well-developed and flying but still being fed by one adult), 19 (2), 30 (2), July 1 (2), August 1 (4). Others were seen at New Perth, June 1 (1); 10 miles west of Souris, June 7 (2), 9 (2); 11 miles west of Souris, June 10 (1); 8 miles south of St. Peters, July 3 (1 juv.). One at Hermanville on June 13 was violently but briefly pursued by a blue jay.

Specimen examined:

Hermanville: 1 ad. ♂; June 13, 1952.

This specimen, although worn and faded, is in colour closer to comparable Newfoundland material than to *canadensis*.

Northern Blue Jay. *Cyanocitta cristata bromia* Oberholser

Not uncommon permanent resident; breeds. In 1952, the writer observed it almost daily in most parts of the island visited, six being the maximum number seen in any one day (July 21). On June 9 one was seen carrying a stick evidently for use as nesting material.

Specimens examined:

Souris (11 miles west): 1 ad. ♂; June 10, 1952.
Dingwell Mills: 1 juv. ♂; July 2, 1952.

Northern Raven. *Corvus corax principalis* Ridgway

Not uncommon permanent resident; breeds. Prince Edward Island is a notable exception to Taverner's (1922) observation that the raven retreats before the advance of civilization. On the contrary it appears to have increased in the past few decades in this highly cultivated island. Bain (1891) did not mention its occurrence. Dwight (1893) observed none and placed it hypothetically in his list on the basis of a report that it had nested at East Point. MacSwain (1912) called its occurrence accidental while reporting two shot at Montague in 1904. Had it been present in the numbers we found in 1952, Dwight surely would have observed it. It was recorded in the northeastern part of the island between Mount Stewart and East Point, as follows: May 31 (4); June 1 (2), 4 (2), 5 (1), 7 (2), 9 (2), 11 (1), 13 (1), 14 (1), 16 (3), 17 (4), 20 (2), 22 (5), 23 (6), 25 (10), 27 (4), 29 (5); July 1 (3), 2 (3), 3 (3), 6 (1), 10 (3), 28 (19), 30 (5), 31 (4); August 1 (1), 4 (6). In other parts it was seen at High Bank, July 14 (3); Richmond, July 16 (2); Brackley Beach, July 17 (3); Cavendish, July 17 (2), 26 (4); North Point and Tignish River, July 18 (5); Big Miminegash Pond, July 21 (2); Cavendish Inlet, July 22 (1); St. Louis, July 25 (1). First flying young noted on June 22 at McKinnon Point. On June 13, Crosby collected one while it was destroying a nest of the robin, *Turdis migratorius.* This was some 15 feet up in a conifer; the nest was empty when Crosby killed the raven. One dead young robin, still warm and almost ready to leave the nest, was found on the ground below. Peters (MS.) located two nests with young in 1945, one near the cormorant colony at Cape Tryon on May 13. The other was seen on May 9, but the exact locality is not given.

Specimen examined:

Hermanville: 1 ad. ♂; June 13, 1952.

Eastern Crow. *Corvus brachyrhynchos brachyrhynchos* Brehm

Very common permanent resident; breeds. Dwight (1893) was impressed by the numbers he observed in the breeding season. It remains probably fully as common now. As in Dwight's time, refuse from lobster-canning establishments is still used as a fertilizer on the fields, and crows still congregate in such places in some numbers. Often each post of a considerable length of fence has a crow on it. One such congregation of 108 was noted by the writer at Tignish on July 16. Another flock of more than 300 was observed at dusk near Little Tignish River on July 18. First flying young were seen on June 27. MacSwain (1908) stated that numbers are somewhat fewer in winter.

Specimens examined:

Charlottetown: 1 ad. unsexed: April 27, 1920; Murdock MacLeod.
Dingwell Mills: 1 ad. ♀; July 2, 1952.

Eastern Black-capped Chickadee. *Parus atricapillus atricapillus* Linnaeus

Not uncommon permanent resident; breeds. In 1952, the writer observed it in well-scattered localities throughout the island. Bain (1891) stated that it is common in winter and that it breeds.

Specimens examined:

Northern Kings County: 5♂, 1 ad. unsexed; June 7–July 28, 1952.
Mount Stewart: 1 ad. ♀; June 5, 1952.

They apparently do not tend toward the dark Newfoundland race.

Acadian Boreal Chickadee. *Parus hudsonicus littoralis* (Bryant)

Not uncommon permanent resident mainly in coniferous woodland; breeds. In 1952 the writer observed it almost daily, usually in small numbers, in well scattered localities throughout the area. A nest examined on June 17 was in the hollow of a low decayed stump. The nest was about 18 inches from the top, which was quite open, as also were two sides down to within 6 inches of the nest. The latter presumably would be badly exposed to stormy weather. The incubating adult made soft hissing sounds and refused to leave the nest although the writer's face was only 18 inches distant.

Specimens examined:

Northern Kings County: 6 ad. ♂, 1 ad. ♀; June 9–21, 1952.

Measurements of the wings of 6 males are (in mm.): 61·0 to 6·35 (average, 62·2); of one female, 57·1. In colour, too, they are typical of *littoralis*.

White-breasted Nuthatch. *Sitta carolinensis cookei* Oberholser

Uncommon permanent resident. Bain (1885 and 1891), MacSwain (1908), and Hurst (1947) refer to this species; MacSwain and Hurst asserting that it is common. It certainly was not common in 1952, because the only observation was of a single bird by Crosby near Harmony Junction on July 8. Moreover, Dwight (1893) failed to record it. J. Frank Sterns informed the writer that it has frequented his feeding shelf during several winters at Souris.

Red-breasted Nuthatch. *Sitta canadensis* Linnaeus

Apparently this species is rare some years, common in others. Bain (1891) stated that it was very common in 1889 but was rare during some seasons. Both he and MacSwain (1908) stated that it breeds. Dwight (1893) saw apparently a family group near Souris, his only observation. Goodwill (MS.) observed three near Souris on August 8, 1948. Bond and Ross (MS.) noted two birds at East Point on June 16, 1949. In 1952, it apparently was absent, or nearly so, for the writer did not record it. Bain (1885) attests to its presence in winter.

Brown Creeper. *Certhia familiaris americana* Bonaparte

Uncommon permanent resident; breeds. In 1952 the writer saw it near Priest Pond, June 23 (1); on Panmure Island, June 23 (1); near Selkirk, July 7 (8); Harmony Junction, July 8 (4), 9 (1), 10 (1); Glencorradale, July 31 (1). They were found in both deciduous and coniferous forest. Bain (1891) stated that it winters.

Specimens examined:

Kings County: 2 ad. ♂, 2 juv. ♂, 2 juv. unsexed; June 23–July 31, 1952.

House Wren. *Troglodytes aedon* subsp.

Probably accidental. The writer saw a mounted specimen in the collection at Prince of Wales College erroneously marked 'Winter Wren', but there were no data on the label. Anstruther Calder assured the writer that he mounted this individual and that it was found dead in Prince Edward Island. He could not give the exact date and locality. It has not previously been recorded from Prince Edward Island.

Eastern Winter Wren. *Troglodytes troglodytes hiemalis* Vieillot

Not uncommon summer resident; breeds. In 1952, it was observed in well-scattered localities throughout the island, usually about clearings in coniferous forest where slashing abounds.

Specimens examined:

Hermanville: 1 ad. ♂, 1 ad. ♀, 3 juv. unsexed; June 30–August 1, 1952.
St. Charles: 1 ad. ♂, June 23, 1952.
St. Peters (8 miles south): 1 ad. ♂, 1 ad. ♀; July 3, 1952.

Eastern Mockingbird. *Mimus polyglottos polyglottos* (Linnaeus)

Probably accidental. Near the southwest corner of Deroche Pond, Queens County, on August 4, 1952, an adult female was collected. It was flying across an open field when first seen by both Crosby and the writer. It perched frequently on fences but was extremely restless and was collected with considerable difficulty. The bird was in good condition and had an incubation patch; stomach contained blueberries and insects. This is the first Prince Edward Island record. Presumably it came to Prince Edward Island after breeding farther south.

Specimen examined:

Deroche Pond: 1 ad. ♀; August 4, 1952.

[**Catbird.** *Dumetella carolinensis* (Linnaeus)

Hypothetical. Macoun and Macoun (1909) stated that a few specimens were seen in July, 1888, at Stewart's Mill. A. F. Calder told the writer that he had seen one at Kensington and one near Alberton but did not record the dates. Hurst (1947) asserted that it was not rare in 1936, a seemingly improbable statement. Although it was not noted by Bain, MacSwain, Dwight, Peters, Bond and Ross, or the writer, it still seems probable that it might be found occasionally when one considers its status in Nova Scotia and New Brunswick. A specimen is needed to establish this, however.]

Eastern Robin. *Turdus migratorius migratorus* Linnaeus

Very common breeding summer resident; rare in winter. In 1952 it was observed daily in all parts of the island visited. First flying young were seen on June 6. Bain (1885) and MacSwain (1908) mention its rare presence in winter. One was seen at Souris on February 16, 1953, by J. Frank Sterns (in litt.).

Specimens examined:

Kings County: 1 ad. ♂, 1 juv. unsexed; June 11–13, 1952.

Eastern Hermit Thrush. *Hylocichla guttata faxoni* Bangs and Penard

Common summer resident; breeds. The writer found it in most localities visited. A nest with six eggs on the ground under a fir sapling in a broad clearing was located on June 9. Singing was heard until August 5 when observation ceased.

Specimens examined:

Kings County: 6 ad. ♂, 1 ad. ♀, 1 juv. ♂; June 9–July 9, 1952.
Mount Stewart: 1 ad. ♂; June 5, 1952.

I detect no definite tendency toward the well-characterized Newfoundland race, H.g. *crymophila* Burleigh and Peters, in these specimens.

Olive-backed Thrush. *Hylocichla ustulata swainsoni* (Tschudi)

Common summer resident; breeds. Like the Hermit Thrush this species is found throughout the island and is only slightly less common. It was still singing when field observations ceased on August 5.

Specimens examined:

Kings County: 5 ad. ♂, 6 ad. ♀; June 9–July 10, 1952.

These specimens show a certain amount of similarity to birds from Newfoundland which Burleigh and Peters (1948) described and named *clarescens*. Although breeding populations from Newfoundland, extreme southeastern Canada, and northeastern United States average slightly different from birds breeding in other parts of the range of *swainsoni*, the writer doubts that the differences are sufficiently constant to constitute a valid race.

[**Veery.** *Hylocichla fuscescens* subsp.

Hypothetical. Macoun and Macoun (1909) stated that it was "rare in woods at Brackley Point" on July 4, 1888. No one else seems to have found it on the island. The writer looked particularly for this thrush with negative results.]

Eastern Bluebird. *Sialia sialis sialis* (Linnaeus)

Rare visitant. Although apparently not previously recorded from the island, the writer examined a mounted specimen in the collection of Prince Edward Island birds in the Prince of Wales College collection. A. F. Calder (in litt.) states that this is the only specimen taken on the island and that he mounted it for Mr. Earle. It was taken at Yorke, near Charlottetown.

Eastern Golden-crowned Kinglet. *Regulus satrapa satrapa* (Lichtenstein)

Rather common permanent resident; breeds. In 1952 the writer found it in coniferous woodland throughout the island. Twelve was the largest number noted on any one day (June 30, July 28, and August 1). Bain (1885) gave its winter status. MacSwain (1908) stated that it breeds.

Specimens examined:

Kings County: 2 ad. ♂, 1 ad. ♀; June 12–21, 1952.

Eastern Ruby-crowned Kinglet. *Regulus calendula calendula* (Linnaeus)

Rather common summer resident in coniferous woodland throughout the island. The records suggest that this kinglet may have increased numerically on the island within recent times. It seems strange that Dwight (1893) did not find it at all, for it would appear unlikely that he would miss the conspicuous song had this species then been present in the numbers the writer found. Nevertheless earlier Bain (1885) did not stress its rareness in recording it from the island. Perhaps its scarcity during Dwight's visit was temporary. Both MacSwain (1908) and Hurst (1947) considered it quite rare. Bond and Ross (MS.) recorded it on five of the six days they spent on the island in 1949. In 1952 the writer noted it in various localities as follows: May 31 (4); June 1 (6), 3 (6), 5 (8), 6 (6), 7 (5), 9 (4), 10 (8), 11 (5), 12 (5), 13 (8), 14 (4), 17 (6), 18 (5), 19 (6), 23 (3), 25 (2), 28 (2), 30 (4); July 1 (4), 2 (5), 3 (3), 5 (4), 7 (4), 8 (1), 9 (1), 10 (2), 19 (1), 25 (1), 28 (2). The smaller numbers noted in July are probably due to decreasing song. MacSwain (1908) stated that it breeds. Hurst (1947) recorded a winter record of one found dead on a doorstep at Killross in February, 1934. Apparently this was not examined by any authority, and it may have been a golden-crowned kinglet. Goodwill's (MS.) latest record in 1947 was October 12 near Murray Harbour Village.

Specimens examined:

Kings County: 4 ad. ♂; June 10–July 10, 1952.
Mount Stewart: 1 ad. ♂; June 6, 1952.

American Pipit. *Anthus spinoletta rubescens* (Tunstall)

Transient. Bain (1891) described it well and said that it occurs in autumn. MacSwain (1908) stated that he saw one that was shot, from a flock of five, at Pownal in January, 1904. If correct this must be most unusual, for one would not expect it there in winter. Hurst (1947) called it a migrant and in the writer's copy appears the marginal notation in Hurst's longhand "Great incursion in Mar., 1947".

[**Bohemian Waxwing.** *Bombycilla garrulus* (Linnaeus)

Hypothetical. Hurst (1947) stated that it was seen in the winter of 1915-16, but he did not say who saw it or where it was seen.]

Cedar Waxwing. *Bombycilla cedrorum* Vieillot

Rather uncommon summer resident; breeds. In 1952 the writer observed it as follows: Hermanville, June 19 (1); Dingwell Mills, July 2 (2); near Montague, July 14 (2); Greenhill, July 16 (3); near North Point, July 18 (1); West Devon, July 19 (2); Inverness, July 19 (1); Burton, July 21 (2); Cavendish Inlet, July 22 (2); Conway Cove, July 22 (1); Portage, July 24 (2); Indian River, July 26 (2); East Point, July 30 (1); Deroche Pond, August 4 (6); Fortune River, August 5 (2). MacSwain (1908) attests to its breeding.

Northern Shrike. *Lanius excubitor borealis* Vieillot

Winter visitor. Bain (1891) and MacSwain (1908) mentioned its occurrence in autumn and winter. Hurst (1947) asserted that it was not uncommon in the winters of 1932, 1933, and 1934. J. Frank Sterns (oral) observed it at Souris as follows: one on March 6, 1935; seven in the winter 1936; one on February 4, 1941; and one on March 5, 1947.

[**Common Shrike.** *Lanius ludovicianus* Linnaeus

Hypothetical. MacSwain (1908) referred to this species only vaguely, asserting that it is rarer than the northern shrike. A shrike observed at Priest Pond on August 12, 1948, by J. Frank Sterns (MS.) may have been this species.]

European Starling. *Sturnus vulgaris vulgaris* Linnaeus

Abundant permanent resident; breeds. Hurst (1947) stated that it was first observed at Souris in February, 1931, by J. Frank Sterns and that Ludlow Jenkins reported "thousands" at Suffolk in the autumn of 1933. Myrick (1931) recorded starlings at Tignish, probably in late 1930 or early 1931. Lewis (1934) recorded a flock of eighteen at Pownal on September 24, 1932. McManus (1936) recorded four at Alberton on June 29, 1935.

In 1952, it was generally distributed and was seen daily in varying numbers. It was observed nesting in mail boxes, telephone poles, tree cavities, under gables in houses, and at Greenhill and Orby Head in cavities in clay banks at the water's edge. Flying young (flock of eighteen) first noted on June 20.

[**White-eyed Vireo.** *Vireo griseus* (Boddaert)

Erroneously recorded. The only evidence of its unlikely occurrence is MacSwain's (1908) assertion that it is not common. Hurst (1947) correctly excluded the species from his list.]

[**Yellow-throated Vireo.** *Vireo flavifrons* Vieillot

Erroneously recorded. MacSwain's (1908) comment that it is "more numerous than the red or white-eyed vireo" is obviously a case of confusion with some other species. Hurst (1947) correctly excluded it.]

Blue-headed Vireo. *Vireo solitarius solitarius* (Wilson)

Rather uncommon summer resident. In view of the fact that Dwight (1893) observed only one and Bain (1891), MacSwain (1908), and Hurst did personally record it, the writer's observations, all in Kings County, are given in detail: June 6 (1), 7 (2), 9 (4), 12 (3), 14 (1), 19 (2), 23 (1), 30 (1); July 3 (1), 7 (1), 9 (1), 10 (1); August 1 (1). Macoun and Macoun (1909) stated that it was seen at Hunter River on July 2, 1888.

Specimens examined:

Kings County: 4 ad. ♂, 1 ad. ♀; June 9–July 7, 1952.

Red-eyed Vireo. *Vireo olivaceus* (Linnaeus)

Common summer resident in mainly deciduous forest throughout the island; breeds.

Specimens examined:

Kings County: 1 ad. ♂, 1 ad. ♀; June 12–17, 1952.
Mount Stewart: 1 ad. ♂; June 5, 1952.

[**Warbling Vireo.** *Vireo gilvus* (Vieillot)

Hypothetical. MacSwain's (1908) statement that small flocks are sometimes seen on their way northward seems extremely unlikely. There is no evidence that a specimen he examined from Brackley Point was seen by an authority. The writer agrees with Hurst (1947) that the records are not acceptable.]

Black and White Warbler. *Mniotilta varia* (Linnaeus)

Summer resident in small numbers throughout the island. In 1952, the writer recorded it on sixteen dates, between June 1 and August 5, but saw no more than three on any one date.

Specimens examined:

Kings County: 3 ad. ♂; June 10–July 10, 1952.

[**Golden-winged Warbler.** *Vermivora chrysoptera* (Linnaeus)

Hypothetical. MacSwain's (1908) vague statement that one was seen on June 5, 1897, is inadequate evidence of the occurrence of this warbler far out of its known range. Hurst (1947) placed it in his list of excluded species.]

Tennessee Warbler. *Vermivora peregrina* (Wilson)

Rather uncommon summer resident. In 1952 the writer observed it in Kings County, as follows: June 5 (2), 10 (4), 14 (1), 17 (2), 19 (3), 23 (4), 25 (2), 28 (3), 30 (4); July 1 (1), 4 (2), 5 (3), 7 (2). It was seen also at

Montague, July 14 (1); Portage, July 19 (1); and at O'Leary, July 21 (1). It preferred boggy areas. Dwight (1893) did not record this species, but Bain (1891) mentioned its presence earlier. MacSwain (1908) saw only three and Hurst (1947) had no personal experience with it.

Specimen examined:

Souris (11 miles west): 1 ad. ♂; June 10, 1952.

Nashville Warbler. *Vermivora ruficapilla ruficapilla* (Wilson)

A summer resident, commoner than the Tennessee warbler. In 1952, the writer noted it with fair regularity in Kings County, nine being the largest number seen in a day (June 5). On the west end of the island three were seen near St. Louis on July 25. Dwight (1893) called it rather abundant at Tignish; Bond and Ross (MS.) noted it on two of six days of observation, and Goodwill (MS.) observed one on September 5, 1948.

Specimens examined:

Kings County: 2 ad. ♂; June 17–20, 1952.

Northern Parula Warbler. *Parula americana pusilla* (Wilson)

Common summer resident. The writer observed it in Kings County on June 1 (4), 3 (1), 5 (1), 6 (2), 7 (1), 9 (8), 10 (2), 11 (3), 12 (4), 13 (6), 14 (6), 17 (2), 18 (7), 19 (6), 20 (2), 21 (1), 23 (3), 26 (1), 28 (5), 30 (2); July 1 (2), 2 (3), 3 (3), 5 (3), 7 (3), 8 (6), 9 (4), 10 (5). It was observed also near Harmony, Tignish, West Point, Haliburton, and Foxley Bay. Latest song heard was on August 1. Bond and Ross (MS.) noted it on four of six observation days in 1949. Dwight (1893) observed it infrequently; MacSwain (1908) considered it not common; and Hurst (1907) referred only to Dwight's observations.

Specimens examined:

Kings County: 4 ad. ♂, 2 ad. ♀; June 9–July 9, 1952.

Northern Yellow Warbler. *Dendroica petechia amnicola* Batchelder

Fairly common summer resident; breeds. The writer observed it regularly in small numbers at most localities visited. A nest in a rose-bayberry patch, examined on June 21, contained four eggs.

Specimens examined:

Kings County: 4 ad. ♂, 2 ad. ♀; June 21–26, 1952.

These specimens are intermediate between *amnicola* and *aestiva* but are nearer the former.

Magnolia Warbler. *Dendroica magnolia* (Wilson)

Common summer resident in coniferous forest; breeds. MacSwain (1908) stated that it was rare and that it was more frequently seen years before he wrote. Hurst (1947) gave but two records. Doubtless they cofused it with other warblers, for Dwight (1893) spoke of its abundance in 1892, and his observations agreed closely with the writer's in 1952. Bond and Ross (MS.) found a nest with four eggs on June 15, 1949. Goodwill's (MS.) latest record in 1947 was September 21.

Specimens examined:

Kings County: 4 ad. ♂; June 12–July 3, 1952.

Cape May Warbler. *Dendroica tigrina* (Gmelin)

Rare summer resident. The only previous record appears to be that of MacSwain (1908) who observed one near Charlottetown on September 2, 1899. The writer observed one on June 10, about ten miles west of Souris; and in the heavily wooded country in the vicinity of Hermanville two males and a female were noted on June 17 (two males collected). Single singing males were noted in that area on June 19, 28, and 30, and near Big Pond on June 23.

Specimens examined:

Hermanville: 2 ad. ♂; June 17, 1952.

Black-throated Blue Warbler. *Dendroica caerulescens caerulescens* (Gmelin)

Rare summer resident. Previously recorded only by Dwight (1893) who stated that he detected a few at Souris. In 1952, the writer noted a singing male some eleven miles west of Souris on June 10, 1952, and near Harmony Junction on July 8 a singing male was collected. On July 9 four singing males were counted in the latter area. All were in mature deciduous forest.

Specimens examined:

Harmony Junction (2 miles N.E.); 2 ad. ♂; July 8–9, 1952.

Eastern Myrtle Warbler. *Dendroica coronata coronata* (Linnaeus)

Very common summer resident; breeds. In 1952 the writer observed it daily in all wooded localities visited. A female was seen carrying nesting material on June 7. Goodwill (MS.) in 1947 observed it until October 26.

Specimens examined:

Kings County: 3 ad. ♂; June 12–July 28, 1952.

Black-throated Green Warbler. *Dendroica virens virens* (Gmelin)

Very common summer resident; breeds. In 1952 the writer observed it daily in coniferous woods throughout the island. Dwight's (1893) observations are similar. Goodwill (MS.) noted one on September 15, 1948, at Souris.

Specimens examined:

Kings County: 4 ad. ♂, 1 ad. ♀; June 7–30, 1952.
Mount Stewart: 1 ad. ♂; June 6, 1952.

Blackburnian Warbler. *Dendroica fusca* (Müller)

Uncommon summer resident. MacSwain (1908) seems to be the only previous writer to record this species, noting that very few have been seen on the island. In 1952 the writer observed it on eight dates, but no more than three were seen on any one date. All observations were in northeastern Kings County. Goodwill (MS.) saw one on September 5, 1948, near Souris.

Specimens examined:

Souris (10 to 11 miles west): 1 ad. ♂, 1 ad. ♀; June 9–12, 1952.
Harmony Junction: 1 ad. ♂; July 10, 1952.

Chestnut-sided Warbler. *Dendroica pensylvanica* (Linnaeus)

Rare summer resident. Crosby collected a singing male on June 6 near Mount Stewart and observed another near New Harmony on July 8. On June 23, the writer observed a singing male near St. Charles. This species has not previously been recorded from Prince Edward Island.

Specimen examined:

Mount Stewart (2 miles east): 1 ad. ♂; June 6, 1952.

Bay-breasted Warbler. *Dendroica castanea* (Wilson)

Uncommon summer resident. Macoun and Macoun (1909) recorded a pair seen near Black River on July 18, 1888. Dwight (1903) did not record it, and MacSwain (1908) noted only that he had seen a mounted specimen. In 1952 the writer observed it only in northeastern Kings County but found it locally common in the relatively extensive coniferous woods near Hermanville. Eight were noted there on June 19, and the species was observed on twelve dates.

Specimens examined:

Hermanville: 2 ad. ♂; June 14–17, 1952.
Souris (11 miles west): 1 ad. ♂; June 10, 1952.
Glencorradale: 1 ad. ♂; July 5, 1952.

Black-polled Warbler. *Dendroica striata* (Forster)

Transient. MacSwain (1908) stated that he saw one on June 16, 1905, and had seen only one previously. Hurst (1947) gave a sight record from Pownal, May 31, 1922, and another from Souris in 1936. J. Frank Sterns (MS.) saw one at his home on June 9, 1940. Goodwill (MS.) saw one at Swanton Point on May 30, 1948, and another near Deane Point, on June 13, 1948. Both localities are near Souris. It has not been recorded by others, nor was it seen by the writer. Probably the birds observed by others are transients as the species is one of the seasonally latest warbler migrants in spring in other parts of the Maritimes. However, it breeds on coastal islands in Nova Scotia, and it may yet be found to breed sparingly in Prince Edward Island.

[**Pine Warbler.** *Dendroica pinus* (Wilson)

Hypothetical. Included in the list of Bain (1891), MacSwain (1908), and Hurst (1947), but the evidence they give of its occurrence is inadequate.]

Yellow Palm Warbler. *Dendroica palmarum hypochrysea* Ridgway

Rather common summer resident; breeds. Bain (1891) asserted that it was rare; MacSwain (1908) did not personally observe it at all; Dwight (1893) noted only one, an incubating female at Tignish. It certainly is not rare now. Bond and Ross (MS.) noted it on four of the six days they spent observing birds there in 1949. In 1952, the writer recorded it as follows: In Kings County on June 3 (3), 5 (2), 6 (6), 7 (2), 10 (3), 11 (4), 12 (3), 13 (3), 14 (2), 17 (1), 19 (1) 21 (1), 23 (3), 26 (2), 28 (2); July 1 (1), 5 (1); August 1 (8), 2 (2), 4 (21), 5 (6). It was noted also on the west end of the island at Portage, July 19 (2); Campbellton, July 21 (1); Conway Cove, July 23 (1) and near St. Louis, July 25 (5).

These observations possibly suggest that the species is commoner now than when Bain, Dwight, and MacSwain made their observations. Goodwill's (MS.) latest 1947 observation was of one on October 12 at Fox River.

Specimens examined:

Kings County: 9 ad. ♂; 2 ad. ♀; June 6–July 5, 1952.

Eastern Oven-bird. *Seiurus aurocapillus aurocapillus* (Linnaeus)

Locally not uncommon summer resident in deciduous woodland; breeds. In 1952 the writer observed it in Kings County on June 3 (1), 11 (6), 12 (3), 17 (2), 19 (2), 30 (3); July 7 (5), 8 (15), 9 (6), 10 (1). Observed also in the western part of the island at Haliburton, July 21 (4); St. Louis, July 21 (1). Hurst (1947) recorded a nest at Marshfield in 1914.

Specimens examined:

Kings County: 8 ad. ♂; June 11 – July 10, 1952.

They appear to show no considerable tendency toward *S. a. furvior* from Newfoundland.

Northern Water-Thrush. *Seiurus noveboracensis* subsp.

Rare summer resident. Dwight (1893) noted a few at Tignish, and Hurst (1947) recorded it from Smelt Creek in 1931. According to the writer's files, Dwight collected specimens. Boyer and Addy (MS.) saw one near Summerside on July 21, 1949.

Morning Warbler. *Oporornis philadelphia* (Wilson)

Not uncommon summer resident; breeds. This warbler was not recorded by Bain (1891). MacSwain (1908) asserted that it was rare, and Hurst (1947) gives only one additional record. Dwight (1893) considered it apparently rare although he observed a few at Souris. It was not rare in 1952, for the writer observed it in Kings County as follows: June 7 (2), 9 (4), 10 (2), 11 (4), 12 (3), 13 (1), 16 (1), 17 (1), 18 (3), 19 (2), 23 (1), 28 (4), 30 (2); July 1 (3), 2 (4), 3 (2), 7 (3), 9 (2), 10 (6); August 1 (4). A single was also noted at Portage on July 19, and another opposite Cavendish Inlet on July 22. A female carrying food on July 9 near Harmony Junction obviously had young. Bond and Ross (MS.) observed two near Mansfield on June 16, 1949, and noted the species in another locality on the following day.

Specimens examined:

Kings County: 2 ad. ♂, 2 ad. ♀, 1 juv. unsexed; June 7–August 1, 1952.

Northern Yellow-throat. *Geothlypis trichas brachidactyla* (Swainson)

Very common summer resident; breeds. The old records indicate that formerly it was decidedly less common. Bain (1891) did not mention it; MacSwain (1908) called it not common; Macoun and Macoun (1909) stated that it was seen at Hunter River on July 2, 1888. One might perhaps attach less significance to these reports of its being uncommon had not a highly competent observer like Dwight (1893) stated that he found it sparingly distributed in the western part of the island and that he failed to find it at all in the eastern part about Souris where it now is very common. In Kings County the writer noted it on May 31 (3); June 1 (1), 3 (7), 5 (14), 6 (18), 7 (3), 9 (4), 10 (14), 11 (8), 12 (8), 13 (8), 14 (9), 16 (2), 17 (7), 18 (4), 19 (4), 21 (3), 23 (5), 25 (4), 26 (4), 27 (2), 28 (6), 30 (3); July 1 (4), 2 (3), 3 (3), 4 (6), 5 (3), 7 (3), 9 (2), 30 (4), 31 (4); August 1 (4), 2 (3), 4 (2). In other parts of the island it was equally common or more so, as the following observations made mainly in the western part indicate: June 14 (8), 16 (8), 17 (6), 18 (10), 19 (12), 20 (4), 21 (18), 22 (5), 23 (8), 24 (8), 25 (11), 26 (6), 28 (6). Although no nests were located, young just out of the nest were seen being fed by a parent at Inverness on July 19, 1952. In 1949 Bond and Ross (MS.) observed it on all of the six days they spent there. Goodwill's (MS.) latest 1947 record was of one on September 21 at Fox River.

Specimens examined:

Kings County: 9 ad. ♂, 1 ad. ♀; June 5–August 1, 1952.

Wilson Warbler. *Wilsonia pusilla pusilla* (Wilson)

The only records appear to be one specimen collected by Dwight (1893) at Tignish, probably in late June, 1892; a sight record on August 20, 1944, by Hurst (1947), who did not specify the locality; and one observed by Goodwill (MS.) at Swanton Point, near Souris, on May 30, 1948.

Canada Warbler. *Wilsonia canadensis* (Linnaeus)

Uncommon summer resident. In 1952 it was observed in the Souris area on June 10 (1), 11 (1), 12 (1), 20 (3). One was seen near Haliburton on July 21. Dwight (1893) stated that it was rather common about Tignish, but he did not encounter it elsewhere. Bond and Ross (MS.) saw one near Portage on June 14, 1949. Klugh (1921) noted it on Curtain Island in 1920.

Specimen examined:

Souris (11 miles west): 1 ad. ♂; June 12, 1952.

Northern Redstart. *Setophaga ruticilla tricolora* (Müller)

Common summer resident; breeds. The writer's findings in 1952 accord well with those of Dwight (1893). MacSwain (1908) stated that it breeds.

Specimen examined:

Mount Stewart: 1 ad. ♂; June 6, 1952.

English Sparrow. *Passer domesticus domesticus* (Linnaeus)

Very common permanent resident; breeds. Bain (1891) stated that this bird was first observed in Prince Edward Island at Charlottetown on November 26, 1886. At the time he wrote he said that it had multiplied rapidly there and appeared well established. In 1952 it was generally and commonly distributed throughout.

Bobolink. *Dolichonyx oryzivorus* (Linnaeus)

Rare summer resident. Bain (1891) saw one along Elliot River in the summer of, apparently, 1890. He described the bird satisfactorily. MacSwain (1908) called it a rare summer visitor. Hurst (1947) stated that Ludlow Jenkins saw several in 1933 and that Maude M. Jones observed it at Pownal in 1937. A. F. Calder (oral) has mounted two but did not record the data concerning their occurrence. Goodwill (MS.) saw a male between Pinette River and Eldon, Queens County, on May 26, 1951.

Eastern Meadowlark. *Sturnella magna magna* (Linnaeus)

Very rare visitant. MacSwain (1908) examined a specimen which he said was collected by Earle in western Prince County. A. F. Calder (oral) mounted one which was shot by Professor Earle about 1904 or 1905, perhaps the same bird recorded by MacSwain (op. cit.). The writer saw this specimen in the Prince of Wales College collection. It was without data, but Calder stated that it was the one he mounted.

Eastern Red-wing. *Agelaius phoeniceus phoeniceus* (Linnaeus)

Fairly common summer resident in fresh-water marshes; breeds. This is another species that appears to have increased in recent years. Although Macoun and Macoun (1909) recorded "one pair at Cove Head Mill. . . on 5th July, 1888", Dwight (1893) failed to find it and Bain (1891) did not mention it. MacSwain (1908) adds merely that two were seen at Cove Head in July, 1905. However, Hurst (1947) stated that according to J. Frank Sterns, it was common at East Lake about 1908 but was absent there in 1933. In 1952 there were about twenty-seven in the East Lake marshes. The writer found small numbers in most suitable marshes from one end of the island to the other. Had this species been similarly common in Dwight's time, he surely would have recorded it. A nest was observed at Harmony Junction on June 21, 1952.

Specimens examined:

East Lake: 1 ♂; 2 ♀; July 4, 1952.
St. Peters: 1 sub-ad. ♂; June 25, 1952.
Hermanville: 1 ad. ♀; June 27, 1952.

Baltimore Oriole. *Icterus galbula* (Linnaeus)

Very rare. Bain (1891) mentioned a hearsay report of one seen at Cascumpeque but did not give the date. Macoun and Macoun (1909) stated that a pair were seen on the Charlottetown road, near Brackley Point, on July 10, 1888. MacSwain (1908) recorded one taken at Tignish but gave no other data. A mounted specimen was seen by the writer in the Prince of Wales College collection. A. F. Calder (MS.) collected this in 1932 at Yorke, near Charlottetown.

Rusty Blackbird. *Euphagus carolinus* (Müller)

Uncommon summer resident; breeds, This species has been recorded by Bain (1891), Dwight (1893), and MacSwain (1908). Hurst (1947) excluded it on the grounds that it probably had become extirpated with the advent of the bronzed grackle. The writer noted it in Kings County on June 3 (1), 10 (8), 11 (1), 12 (2), 17 (1), 18 (1), 19 (1), 24 (2); July 1 (3), 28 (1); August 5 (flock of 23 at the head of Fortune River). On June 10 three short-tailed juvenals, barely able to fly, were noted by the writer. Goodwill (MS.) recorded one near Murray Harbour village on September 21, 1947.

Specimens examined:

Souris (11 miles west): 1 ad. ♂, 1 ad. ♀; June 10–11, 1952.

Bronzed Grackle. *Quiscalus quiscula versicolor* Vieillot

Abundant summer resident; breeds. This is another species that apparently has become common in Prince Edward Island in recent times. Bain (1891) stated that "*Quiscalus purpureus* is a less common bird", but whether he actually even saw it is questionable. Macoun and Macoun (1909) recorded one pair at Tracadie on July 11, 1888. Dwight (1893) did not personally observe it, but he stated that he saw two specimens then in Prof. Earle's possession, and said that these were the only ones Earle had ever seen. Dwight considered them stragglers from the mainland. MacSwain (1908) stated that it had become "common within the last three years" and that it was then nesting near Charlottetown. Hurst (1947, p. 20) mentions the advent of this species about the year 1900. He said that there were "thousands" by 1925. In 1952 it was abundant and was seen daily and in substantial numbers in all parts of the island visited, definitely one of the commonest birds. Goodwill's (MS.) latest 1947 date was October 20, when he saw one at Murray Harbour.

Specimen examined:

Souris (11 miles west): 1 ad. ♀; June 18, 1952.

Eastern Cowbird. *Molothrus ater ater* (Boddaert)

Hurst (1947) stated that there was a "specimen reported by Earl Jenkins, Lot 48, summer, 1933." Aside from this, Goodwill (MS.) appears to be the only observer to have noted this species. On October 18, 23, and 26, 1947, he closely observed two at Murray Harbour village.

[**Scarlet Tanager.** *Piranga olivacea* (Gmelin)

Hypothetical. Bain (1891) stated that the only authentic occurrence he knew of was one seen at Morrell by Dr. F. Beer.]

Rose-breasted Grosbeak. *Pheucticus ludovicianus* (Linnaeus)

Rare summer resident. Its present status appears to be very much like that given by Bain (1891), MacSwain (1908), and Hurst (1947). The writer observed only four individuals: a sub-adult male on June 10 about eleven miles west of Souris, two males on July 8 near Harmony Junction, and a female on July 9 also near Harmony Junction.

Specimens examined:

Kings County: 1 ad. ♂, 1 sub-ad. ♂; June 10–July 8, 1952.

[**Indigo Bunting.** *Passerina cyanea* (Linnaeus)

Hypothetical. Hurst (1947) recorded one seen by Ludlow Jenkins at Marshfield in June, 1933.]

Dickcissel. *Spiza americana* (Gmelin)

Rare visitor. MacSwain (1908) saw only one mounted specimen but gave no information on when or where it was taken. Bain (1891) spoke of its "regular" presence in Prince Edward Island but did not mention the season when it was observed. He indicated his awareness that this species breeds farther south. In view of the known occurrence of this species in autumn in other parts of the Canadian Atlantic coast (Godfrey, *in press*), its occurrence in Prince Edward Island is not surprising.

Eastern Evening Grosbeak. *Hesperiphona vespertina vespertina* (Cooper)

Irregular winter resident. Hurst (1947) stated that several were observed in Souris during January and February, 1927, by J. Frank Sterns; also that two were seen by R. B. MacLaren at the Experimental Station on January 22, 1946. Mr. Sterns informed the writer in a letter dated February 14, 1953, that evening grosbeaks had regularly visited his home in Souris from late December, 1952, until the time he wrote. A. F. Calder (MS.) mounted a specimen taken on November 5, 1938, near Port Borden which the writer saw in the Prince of Wales College collection.

Eastern Purple Finch. *Carpodacus purpureus purpureus* (Gmelin)

Fairly common summer resident; breeds. Dwight (1893) found it sparingly distributed, and MacSwain (1908) implied that it had become common only a few years before he wrote. Hurst (1947) stated that Sterns considered that it had increased since 1920. However Bain (1891) did not imply that it was uncommon, and he (1885) stated that it frequently winters. Both Bain and MacSwain said that it breeds. The writer found it fairly common in all suitable habitat visited in 1952 and recorded it as follows: June 1 (2), 3 (6), 5 (7), 6 (3), 7 (6), 9 (8), 10 (7), 11 (3), 12 (2), 13 (4), 14 (4), 17 (2), 18 (1), 19 (2), 21 (3), 23 (3), 25 (1), 30 (3); July 1 (4), 2 (3), 3 (2), 5 (4), 7 (5), 8 (4), 9 (3), 10 (3), 15 (2), 16 (1), 18 (1), 19 (3), 20 (1), 21 (4), 22 (3), 23 (2), 24 (2), 25 (10), 30 (2); August 1 (3). Bond and Ross (MS.) observed it on four of six days they spent on the island in 1949.

Specimens examined:

Kings County: 5 ad. ♂, 1 ad. ♀; June 9–July 1, 1952.
Mount Stewart: 2 ad. ♂; June 5, 1952.

Pine Grosbeak. *Pinicola enucleator* (Linnaeus)

Irregular winter resident. Recorded by Bain (1885), MacSwain (1908), and Hurst (1947). Bain said that it usually arrives in November. Its numbers vary greatly from winter to winter. Although the writer has not examined any actual Prince Edward Island specimens, good winter series have been available from Nova Scotia and New Brunswick, most of them being Newfoundland pine grosbeaks, *Pinicola enucleator eschatosa* Oberholser. Probably Prince Edward Island's winter visitants are mostly referable to the same race.

Common Redpoll. *Acanthis flammea* (Linnaeus)

Irregular winter visitor. Recorded by Bain (1885 and 1891) who stated that it usually arrives in the first week of November, and also by MacSwain (1908) and Hurst (1947). The last author mentioned incursions in 1928 and in the winter of 1935-36, and noted a flock on March 7, 1944. Bain's (1891) statement that "a rare specimen stays with us all summer and builds its nest . . ." requires confirmation. No specimens are available from which to determine the race or races involved.

Northern Pine Siskin. *Spinus pinus pinus* (Wilson)

Not uncommon permanent resident. The writer noted it as follows: June 3 (12), 9 (3), 12 (3), 13 (2), 14 (1), 16 (2), 17 (3), 19 (6), 21 (4), 23 (2), 26 (1), 30 (7); July 9 (1), 26 (1), 27 (2), 28 (2); August 2 (1). Most of the observations were in Kings County, but one was seen in Prince County on July 26 and two at Stanhope on the following date. Dwight (1893) noted but one, which he collected at Souris, a male which appeared to be in breeding condition. Its winter status is mentioned by Bain (1891).

Specimen examined:

Hermanville: 1 ad. ♂; June 20, 1952.

Eastern Goldfinch. *Spinus tristis tristis* (Linnaeus)

Rather common summer resident. In 1952 the writer observed it in most parts visited, ten being the largest numbers seen in a day. Specimens were not taken, and it is referred to the nominate race on geographical grounds.

Eastern Red Crossbill. *Loxia curvirostra minor* (Brehm)

Irregular resident. Bain (1891) recorded large flocks arriving late in the autumn; he (1885) noted many in December, 1877, and January, 1884. MacSwain (1908) stated that it was not uncommon. Dwight (1893) found it more common in early summer of 1892 than the following species, but specimens he collected indicated that breeding was past. It apparently was absent throughout the duration of the 1952 observations. The writer has seen no specimens, but Griscom (1937) in his monographic study placed Prince Edward Island material with *neogaea*. Further collecting may well show that *L. c. pusilla* Gloger also occurs.

White-winged Crossbill. *Loxia leucoptera leucoptera* Gmelin

Irregularly common resident. Bain (1891) said that crossbills come in large flocks some autumns and again are unseen for years. MacSwain (1908) considered this species less frequent than the preceding, but this is a condition that probably varies from year to year. Dwight (1893) found *leucoptera* rather numerous but perhaps not so common as the red crossbill. In 1952, the white-winged crossbill was noted on both the east and west ends of the island, as follows: June 19 (1), 21 (2), 23 (37), 27 (40), 28 (8), 30 (36); July 1 (38), 2 (21), 3 (2), 5 (6), 6 (2), 7 (4), 8 (3), 9 (45), 14 (2), 16 (3), 18 (2), 19 (22), 20 (10), 21 (87), 22 (5), 23 (1), 28 (30), 31 (2); August 1 (3). A female taken on July 28 at Hermanville had an incubation patch. Bond and Ross (MS.) in 1949 saw two on June 15, twelve on the following day, and noted the species in unrecorded numbers on June 14. Moore (1906) recorded an albino female taken at Argyle Shore, on February 11, 1905.

Specimens examined:

Kings County: 3 ad. ♂, 1 sub-ad. ♂, 1 ad. ♀; June 30–July 28, 1952.

Eastern Savannah Sparrow. *Passerculus sandwichensis savanna* (Wilson)

Abundant summer resident. The writer observed it in all localities visited throughout the island in 1952; observations accorded well with those of Dwight (1893). A nest with four eggs was observed at Naufrage on June 14. Goodwill (MS.) in 1947 recorded it until October 26 when he saw one in the Murray Harbour area.

Specimens examined:

Kings County: 12 ad. ♂, 3 ad. ♀; June 7–July 28, 1952.

Southport (near Charlottetown): 1 post-juv. ♂, 1 post-juv. ♀; September 8, 1924. R. M. Anderson.

[**Towhee.** *Pipilo erythrophthalmus* (Linnaeus)

Hypothetical. Sight records given by MacSwain (1908) and Hurst (1947) require confirmation.]

Eastern Grasshopper Sparrow. *Ammodramus savannarum pratensis* (Vieillot)

Probably accidental. On June 25, the writer was surprised to hear a singing grasshopper sparrow in a hayfield some five miles northeast of St. Peters. The bird soon flew out of sight to a distant field and could not be again located that day. On the following morning it was back at almost the same spot where it originally was seen. It was wary and made a succession of flights until it was again lost in a field about half a mile distant. When the writer circled back to this place where it was originally heard, the bird had returned there. This time it flushed within range of my small-gauge gun and was winged. It proved to be an adult male, in excellent condition and with testes fully enlarged. Its singing on a definite territory, to which it returned as noted above, and the condition of the testes strongly suggested breeding, although it was far from its known breeding range. The field was carefully searched on that date and on several later ones, but no additional specimen was noted. This is the first Prince Edward Island record. It has not been recorded from Nova Scotia. Squires (1952) calls it a casual visitant in New Brunswick where, at North Head, Grand Manan, an immature male was collected on October 1, 1930. From Newfoundland there is a single record of one taken on November 27, 1950, and recorded by Peters and Burleigh (1951).

Specimen examined:

St. Peters (5 miles northeast): 1 ad. ♂; June 26, 1952.

Acadian Sharp-tailed Sparrow. *Ammospiza caudacuta subvirgata* (Dwight)

Locally common summer resident in salt and brackish marshes; breeds. In 1952, the writer observed colonies at Fortune River, Hillsborough River, near East Lake, Little Harbour, Howe Bay, Orwell River, Squaw Bay, Miscouche Point, Tignish River, Little Tignish River, Brackley Beach, Crooked Creek, near Lennox Island, Cavendish Inlet, Cavendish Cove, Stanhope, Brackley Beach, Panmure Island, Schooner Pond, and Souris. First flying young noted on July 22. Oddly enough, Dwight (1893) noted it only at Tignish where he saw only a few. Earlier, Brewster (1877) recorded that William Stone found it locally common near Tignish and secured five specimens. Bain (1891), MacSwain (1908), and Hurst (1947) had few definite data, but this is probably due to their overlooking this obscure, locally distributed bird. Goodwill (MS.) saw one near Gladstone on September 21, 1947.

Specimens examined.

Prince County: Cavendish Inlet: 2 ad. ♂; July 23, 1952.

[**Seaside Sparrow.** *Ammospiza maritima* (Wilson)

Erroneously recorded. Bain (1891) and MacSwain (1908) record the occurrence of this species with no definite details. The writer agrees with Hurst (1947) in excluding it.]

Eastern Vesper Sparrow. *Pooecetes gramineus gramineus* (Gmelin)

Locally distributed and not abundant in any locality, although it occurs in all three counties. Dwight's (1893) statement that it is abundant does not accord well with the writer's observations, nor with those of Bond and Ross (MS.) who noted two near Tracadie on June 16 and one near Montague on the following date, 1949. MacSwain's (1908) findings are similar to the writer's. In 1952, it was recorded on twenty-six days between May 31 and August 1. Eight was the largest number counted in one day.

Specimens examined:

Hermanville: 3 ad. ♂; June 13–17, 1952.
Souris (6 miles west): 1 ad. ♂; June 28, 1952.

Slate-colored Junco. *Junco hyemalis hyemalis* (Linnaeus)

Very common summer resident; breeds. Some winter. All accounts agree that this species is common in summer. Bain (1885) states that a few winter; this seems probable considering the winter status in Nova Scotia. In 1952, the writer noted it daily in all localities visited. First flying young noted on June 28.

Specimens examined:

Souris: 2 ad. ♂; June 7–9, 1952.

Eastern Tree Sparrow. *Spizella arborea arborea* (Wilson)

Spring and autumn transient and winter resident. Recorded for autumn and winter by Bain (1885) and for spring by MacSwain (1908). Goodwill (MS.) saw six on October 26, 1947, in the Murray Harbour area.

Eastern Chipping Sparrow. *Spizella passerina passerina* (Bechstein)

Common summer resident; breeds. Dwight (1893) stated that it was not a common species and that it was only occasionally observed. MacSwain's (1908) statement that it is common is in accord with the writer's observations. It was noted in 1952 almost daily in all counties of the island. Bond and Ross (MS.) too observed it on all six of the days they spent there in June, 1949.

Specimen examined:

Hermanville: 1 ad. ♂; June 13, 1952.

[**Field Sparrow.** *Spizella pusilla* (Wilson)

Hypothetical. MacSwain's (1908) statement that he has seen it on three occasions and that it breeds is highly questionable.]

White-crowned Sparrow. *Zonotrichia leucophrys leucophrys* (Forster)

Irregular transient. Hurst (1947) recorded a flight over the island in spring, 1933. There seems little reason to doubt this, because a similar flight occurred in Nova Scotia that spring when on May 16 first specimen records for Nova Scotia were secured by J. W. Piggott and the writer. The Nova Scotia flight was recorded by Tufts (1933). Hurst (op.cit.) states that the species was noted also in 1939 by Maude M. Jones at Pownal, P.E.I. Goodwill (MS.) observed one on May 27, 1951, at Canoe Cove, Queens County.

White-throated Sparrow. *Zonotrichia albicollis* (Gmelin)

Common summer resident; breeds. In 1952 the writer observed it almost daily in all parts of the island where appropriate habitat is present. Seventeen was the largest number counted in a day (July 21). A nest with four eggs, under a white spruce sapling, was noted on June 6 near Mount Stewart. Goodwill's (MS.) latest 1947 date was October 25 when he saw one at Murray Harbour.

Specimens examined:

Kings County: 2 ad. ♂; June 16–28, 1952.
Mount Stewart: 1 ad. ♂; June 5, 1952.

Eastern Fox Sparrow. *Passerella iliaca iliaca* (Merrem)

Spring and autumn transient. Recorded by Bain (1891), MacSwain (1908), and Hurst (1947). Goodwill (MS.) in the Murray Harbour area saw one on October 5, seven on October 12, two on October 13, one on October 25, and one on October 26, 1947.

Lincoln Sparrow. *Melospiza lincolnii lincolnii* (Audubon)

Uncommon summer resident; breeds. There appears to be only one previous record: Macoun and Macoun (1909) located a breeding pair at Brackley Point on June 26, 1888. The writer observed it in 1952 as follows: near Mount Stewart a singing male was collected on June 5; single singing males were noted west of Souris on June 9 and 18; one at Hermanville on June 24 and August 1; one at Clear Spring, June 30; two near Selkirk on July 7. Most were observed in boggy places where alders abound. One singing male at Hermanville was observed in a dry field, sparsely wooded with immature white spruce.

Specimens examined:

Mount Stewart: 1 ad. ♂; June 5, 1952.
Selkirk: 1 ad. ♀; July 7, 1952.

Southern Swamp Sparrow. *Melospiza georgiana georgiana* (Latham)

Rather common summer resident; breeds. Although MacSwain (1908) and Hurst (1947) regarded it as being rare, this was probably due to their unfamiliarity with it, for Dwight's (1893) observations in 1892 are similar to the writer's in 1952. It was found on the edges of fresh-water lakes, streams, and marshes throughout the island, nine being the largest number seen in a day. Although no actual nests were found, the behaviour of adults left little doubt that it breeds. Goodwill (MS.) in 1947 recorded the species until October 26 when he saw two in the Murray Harbour area.

Specimens examined:

Kings County: 6 ad. ♂, 2 ad. ♀; June 6–July 4, 1952.

They show little tendency toward *ericrypta*.

Northern Swamp Sparrow. *Melospiza georgiana ericrypta* Oberholser

Transient. An adult female collected near Mount Stewart on June 6, 1952, is a specimen of *ericrypta*. It probably is a regular transient to and from its breeding grounds farther north.

Specimen examined:

Mount Stewart (2 miles east): 1 ad. ♀; June 6, 1952.

Eastern Song Sparrow. *Melospiza melodia melodia* (Wilson)

Very common summer resident; breeds. The writer found this sparrow generally distributed throughout the island and noted it daily. Thirty-two was the largest daily count (July 25). Young out of the nest were first noted on June 25. Bain (1891) stated that it has been known to winter.

Specimens examined:

Kings County: 10 ad. ♂, 2 ad. ♀; June 16–July 9, 1952.
Mount Stewart: 2 ad. ♂; June 5–6, 1952.

[**Lapland Longspur.** *Calcarius lapponicus* (Linnaeus)

Hypothetical. Hurst (1947) recorded it at Marshfield in February, 1934. He gave also a record from Big Pond on June 7, 1933, an amazingly late date seasonally. Although it probably is a more or less regular transient, definite evidence is needed to establish this.]

Eastern Snow Bunting. *Plectrophenax nivalis nivalis* (Linnaeus)

Spring and autumn transient and winter resident. According to Bain (1891) it arrives in October and departs in April. It is recorded also by MacSwain (1908) and Hurst (1947). In 1938 the writer found one intact in the stomach of a snowy owl which was collected near Charlottetown on March 9, 1938.

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REPORT ON BIOLOGICAL INVESTIGATIONS AT MOULD BAY, PRINCE PATRICK ISLAND, N.W.T., IN 1952

By S. D. MacDonald

INTRODUCTION

The present report is based mainly on the results of a biological expedition to Mould Bay, N.W.T., during the summer of 1952, but also includes some observations made when Charles O. Handley, Jr., and I visited Mould Bay in 1949. The 1949 expedition to the subject area was jointly sponsored by the Smithsonian Institution, Washington, D.C., and the National Museum of Canada, Ottawa.

The purpose of these expeditions was to obtain as much biological material and information as possible during the short spring and summer season of the High Arctic. In the period from April 1 to September 5, 1952, I was engaged in the above-mentioned study for the National Museum of Canada. Bird and mammal collections of taxonomically interesting species were made to supplement the specimens taken in 1949. In addition, fifty lots of marine and freshwater invertebrates, seven species of fish, and a few endo- and ecto-parasites were preserved. A plant collection of 118 numbers was prepared for the National Herbarium. Detailed notes on the wildlife of the area were kept, as well as the numerical status, distribution, and life history of each species. Sketches of courtship display attitudes of several birds were made. Approximately 140 kodachromes, depicting the areas and habitats worked and including a series of close-ups of the wildlife found there, were taken.

During the stay at Mould Bay the writer was most fortunate in having the assistance of Paul F. Bruggemann of the Division of Entomology, Department of Agriculture, who is presently preparing a report on his botanical and entomological studies of the area.

Thanks are also due to the Canadian Department of Transport, Meteorological Division, and to the United States Weather Bureau for permission to use the weather station at Mould Bay as a base for field operations. Without such a favour the expedition would have been impossible. Acknowledgment is gratefully made to the Royal Canadian Air Force for their valuable assistance, and especially to the men who flew the *North Star No. 7517* to Mould Bay on September 5 to evacuate me to the hospital at Montreal for treatment of an infection resulting from a seal bite.

Thanks are extended to Mr. R. F. Hayward of the Canadian Meteorological Division, Officer-in-Charge at Mould Bay Station, and to Mr. E. L. Storey, U.S. Weather Bureau, Executive Officer, for their interest and assistance in making available the station facilities. Personal appreciation is extended to Mr. Darryl M. Maddox for his pleasant companionship and interest in the marine study.

GENERAL DESCRIPTION OF THE AREA

Prince Patrick Island is the most northwestern of the Canadian Arctic Islands and is approximately 7,000 square miles in area. It was discovered by Lieutenant G. F. Mecham, who set out with the sledge *Discovery* on April 4, 1853, from H. M. Ship *Resolute*, at that time in winter quarters on Dealy Island, to search the southern and western shores of Melville Island for the missing expedition commanded by Sir John Franklin.

On May 6, Lieutenant Mecham and his men reached the ice-bound shores of Prince Patrick Island. To Mecham and his men approaching over the ice of Crozier Channel, the new land must have looked most inhospitable. Mountainous pressure ridges and ice hummocks were pushed up against the dark precipitous cliffs, and blowing snow restricted their view to a few feet. With much labour they gained the shore and continued along the western coast, eventually reaching what is known as "Discovery Point".

By this time, provisions were running low, and with supplies for only nine days Mecham turned southward. Arriving at the head of Walker Inlet on May 31, he continued to Butter Bay (75°50′ N., 120°40′ W.), to pick up cached supplies, and from there along the coast, passing the mouth of Mould Bay enroute. On reaching the mouth of Intrepid Inlet he found a cairn erected on a promontory by Commander M'Clintock. The cairn contained a note to Mecham stating that M'Clintock had investigated in that direction. Mecham was very greatly disappointed and returned to the northern part of Melville Island. He touched Eglington Island and continued southward on Melville Island.

In March 1948 the United States Weather Bureau and the Canadian Department of Transport's Meteorological Division established a joint Weather Station at Mould Bay. The original landing by a U.S.A.F. C-47 was made on the largest of the lakes at the western extremity at the head of Mould Bay. The station site was chosen at 76°16·5′ N., 119°27·9′ W. on the east side of Mould Bay about ten miles from its head. This situation seems to be the best vegetated area on the peninsula, and all habitats are available to the biologist within ten miles of the weather station.

The station is situated on a low hill overlooking Mould Bay. To the north of the station along the bay, cliffs rise abruptly from the shore to the height of 300 feet. These slopes are mostly of a gravelly and silt-like nature and are generally unvegetated. Sandstone outcrop appears in several layers along the slopes facing the bay, and fossils of marine invertebrates are very abundant both in the sand along these slopes and in the sandstone outcrops at the summit. Where the outcrop is predominant, the slopes below are covered with scree. About three miles from the station the cliff-like slopes become lower (200 to 300 feet), and the silt is of a finer texture. Fossil shells and casts of marine invertebrates are abundant on the surface here, and the *top* layers of the outcropping sandstone are rich in fossils and shells of the same types. The age is believed to be Jurassic or Lower Cretaceous.

From the summit of the "Bay Cliffs", one has an unobstructed view to the head of Mould Bay and beyond. Along the coast of Mould Bay the terrain generally continues its trend of steeply rising slopes along the shores. Facing eastward one looks down over gently rolling hills and the watershed of the "Station Creek or River." Beyond this valley, the terrain rises again toward the centre of the peninsula, the "Dividing Ridge" at an altitude of a little over 600 feet directly east of the station.

The hilltops are almost completely barren, and in the centre of the peninsula hills of fine sand and silt are predominant. During the autumn and winter, large quantities of this fine sand is mixed with the wind-blown snow. The networks of small streams that lace the surface of Prince Patrick Island, fed by spring melting, carry silt into the main channels and then into the bays and inlets of the sea. As a result, the "Station River", like other main streams, has built up a delta and tidal flat extending almost a mile into Mould Bay. All bottom samples taken in Mould Bay during the marine invertebrate study were of very soft, fine mud. This fine mud or silt is deposited in such volumes that this type of bottom habitat was the only one available for work on marine invertebrates. Marine vegetation was encountered only on the sloping edge of the Station River delta in a depth of about 70 to 80 feet. *Laminaria* sp. is the only one brought up in the dredge, its long olive-yellow leaves and stems weighing the dredge almost to the breaking point. This plant is much smaller and much less common at Mould Bay than at Alert, N.W.T.

The beaches are generally narrow in front of the steeply sloping hills that border Mould Bay. In such areas coarse sand and "shingle" are found; elsewhere, silt-laden streams have built up wide deltas and muddy flats.

During the summer, the ice along the shore is moved by the wind and tides; tumbled masses are pushed ashore on the promontories where it gradually melts. Because of this ice movement, no marine invertebrates were found in less than 15 feet of water. Owing to an early spring, the snow melted quickly, the water forming canals and, eventually, leads in the bay ice. By mid-July many leads were apparent, and on August 9 the ice began to break-up and move out of the bay. Except for occasional ice-masses, the bay was ice-free until freeze-up in early September. Mould Bay has been ice-free twice (1951 and 1952) since the station was established in 1948.

In the watershed towards Crozier Channel and Intrepid Inlet, the hills are low and the land in general is gently rolling. The interior of the peninsula is a rather high plateau much dissected by shallow valleys and small streams. Vegetation occurs only in areas that are well snow covered in winter and remain sufficiently moist during the summer season.

There are no large lakes on Prince Patrick Island; "Landing Lake" at the head of Mould Bay is the only one of any significance. It is fed during the spring and summer by water from the melting snow in the low rolling area surrounding it. The soil texture here is varied by the occurrence of coarse sand and pebbles, but the predominant soil is the previously described silt. "Landing Lake" seems to be a settling basin for the silt-laden waters flowing in from the north and west, and the outlet stream flows crystal clear to Mould Bay over a bed of water-rounded stones and gravel. Situated about 40 or 50 feet above the level of Mould Bay, "Landing Lake" is surrounded by an extensive and well-vegetated marsh. This marsh is at its best along the outlet of the lake and towards the slopes of the hills where the melting snow provides the necessary moisture for the growth of grasses, mosses, and sedges. Small ponds are scattered over the marsh, and here king eiders, brant, and other birds nest and raise their young. "Landing Lake" itself seems to be ice-covered most of the year. Probably only in a very favourable season would it be completely ice-free.

A similar marshy habitat is found along the slopes above the "Station River". This area is much more extensive, and the grassy meadows provide year-round pasturage for several herds of musk-oxen, as well as a breeding ground for many birds.

ANNOTATED LIST OF MAMMALS

Having visited Mould Bay on two occasions three years apart, the writer is able to make comparative notes on the wildlife of the area. Nine species of mammals have been recorded on Prince Patrick Island. The assistance of Austin W. Cameron, mammalogist, National Museum of Canada, in confirming the field determinations of the specimens collected, is gratefully acknowledged.

Polar Bear. *Thalarctos maritimus* (Phipps)

No polar bears have been reported from Mould Bay since 1949, when Handley saw an adult female with one cub at the mouth of Intrepid Inlet. Observations in 1952 were as follows: April 22 (old tracks on bay ice, 2 miles north-northwest of station); May 20 (two sets of old tracks: one about 4 or 5 miles inland east of station, the other at Cherie Bay, mouth of Intrepid Inlet); July 10 (one ancient track on shore of small lake near Snowpatch Point).

Arctic Weasel. *Mustela erminea* Linnaeus

Rare. Two sets of tracks and an abandoned den were the only evidence of weasels found. In 1949 the writer saw one track and found part of a weasel skull in an owl pellet. This fragment is in the National Museum of Canada.

Arctic Fox. *Alopex lagopus* (Linnaeus)

Arctic foxes are not abundant on Prince Patrick Island. Tracks were seen occasionally throughout the time spent at Mould Bay, but only a single specimen was observed. This one, in summer pelage, was being harassed by a pair of long-tailed jaegers, as it trotted along a grassy slope where the jaegers presumably had a nest. Once the fox stood on its hind legs and snapped at the birds as they swooped and hovered just out of reach. Several dens from previous years were found, but none of them had been occupied recently. All were situated on sandy hillsides facing south or west, and each den had several entrances. Fox droppings have so fertilized the immediate area that a carpet of grass has sprung up over the mound of sand at the entrance. Fox tracks were much more common in the vicinity of the station during this spring than in 1949. This is probably due, not to a greater abundance of foxes, but to the fact that lemmings were very scarce and the foxes were forced to frequent the garbage dump as a source of food. Several foxes were killed by the dogs of the station during the winter darkness. No evidence of the "blue" phase of the Arctic fox has been recorded from Prince Patrick Island.

Specimens in the National Museum of Canada:

Three adult males, two adult females.

Measurements (in mm.).

Males: total length, 890, 706, 804; tail, 340, 300, 284; hind foot, 147, 140, 143.
Females: total length, 780, 630; tail, 287, 250; hind foot, 130, 110.

Arctic Wolf. *Canis lupus* Linnaeus

Wolves are more in evidence at Mould Bay than are the foxes. Tracks are also more common in the vicinity of the station, the animals being attracted by the garbage.

On June 4, a large white wolf came into the camp area where the dogs were tethered, about 50 yards from the living quarters. The dogs seemed terrified and howled dismally while the invader, standing within a foot of the largest dog, gulped the other's supper. The wolf completely ignored the howling dogs, including the one at the side making half-hearted snarls in his direction. This wolf seemed completely fearless, standing and snarling at the writer as he approached to within 20 yards, before it ran off. It was very thin and weighed only 50 pounds; this figure would have been much less had the weight of the stomach contents been subtracted. The stomach contents were as follows: hair, hoofs, bones of a calf musk-ox; one lemming (swallowed whole); remains of two ptarmigan; two paws of a dog killed at the station (these were also swallowed whole); and about a quart of bones, some of which were as large as 1½ inches square. All wolf stomachs examined at Mould Bay contained about the same quantity of these coarse bone fragments. The writer previously mentioned the described specimen as much emaciated, and the same is true of all wolves examined. This was not surprising when it was discovered that the intestinal tract of each was almost completely lined with large tapeworms. A pint of these parasites was removed from the large white wolf killed in the camp area. On August 16, Mr. Bruggemann found the partly decayed carcass of a large male wolf, which was very thin. Since there were no visible wounds, and although the canine teeth were badly worn, it was thought that death may have been caused by internal parasites. During the early summer, a wolf travelling along the bay ice discovered the carcass of a dog. The wolf apparently was ravenous and ate so much from the carcass that it was unable to run beyond a few hundred yards. In this condition it was easily shot. From their leanness it is evident that the wolves on Prince Patrick Island do not fare well during the winter and early spring. Caribou are fairly common, but wolves do not appear to be able to kill many. The writer has seen tracks where two wolves have tried to run down a caribou. In one case they may have been successful, for this particular caribou left a very awkward trail in the deep snow and was throwing up paunch contents as it ran. On another occasion two wolves were seen attempting to get two caribou as they fed along a vegetated slope. The writer was surprised at their unsuccessful stalking and apparent bungling of their efforts. Whether they were in earnest or merely playing with the caribou it was not known, but certainly they did not display the intelligence and cunning usually associated with hunting wolves.

In 1949, Handley discovered in a sandy hillside a wolf's den which contained young, but no dens were found in 1952. The earliest evidence of young was on August 19 when the tracks of two adults and two young were noted on the sandy beach opposite the station.

Observations: May 5 (4); 27 (3); 30 (1); June 4 (1); 6 (3); 7 (2); 8 (1); 12 (2); 13 (4); 14 (2); 15 (4); 16 (3); 17 (4); 18 (3); 19 (2); 21 (1); July 1 (1); 2 (1); 10 (track); 17 (track); 31 (track); August 16 (1); 19 (four sets of tracks; two young); 27 (tracks common; seem to follow stream beds, edges of ponds, and shore of bay).

Specimens in National Museum of Canada:

3 adult males, 1 adult female.

Measurements (in mm.)

Males: total length, 1,515, 1,375, 1,690; tail, 445, 385, 450; hind foot, 285, 269, 300.
Female: total length, 1,375; tail, 397; hind foot, 163.
Also two partial skulls.

Ringed Seal. *Phoca hispida* Schreber

Seals are not common at Mould Bay and are very difficult to approach because of their extreme wariness. On August 19 two ringed seals were seen swimming and diving around a hen eider and four nearly grown young. The ducks were frantic with fear and came swimming and flapping to shore almost at my feet, but in the race for safety one of the young was pulled under. Its partly-eaten carcass was found, washed ashore a few days later. This is the only time the writer observed seals molesting birds.

Specimen in National Museum:

1 sub-adult female.

Measurements (in mm.):

Total length: 961; tail, 140; hind foot, 255.

Bearded Seal. *Erignathus barbatus* (Erxleben)

Less common than the ringed seal at Mould Bay. Positively identified only three times during the summer.

Collared Lemming. *Dicrostonyx groenlandicus* (Traill)

Very rare in 1952. Evidence of its occurrence noted only four times during the field season at Mould Bay. In 1949, lemmings were very common, and occupied dens could be found on every vegetated hillside. Many of these dens were opened and occasionally contained young from two litters. During this period of abundance approximately 102 specimens were collected; they represent an almost complete series of the pelage changes from April to October.

Arctic Hare. *Lepus arcticus* Ross

Fairly common and more abundant than in 1949. In early spring these hares could be seen feeding on the hillsides northeast and northwest of the station. These areas were particularly suitable as they afforded a good supply of food, and the rocky slopes of the nearby "Bay Cliffs" offered protection from storms and a refuge from the station dogs. In the leaside of boulders, the hares take shelter and often excavate dens in the large, hard-packed snowdrifts. The writer has never discovered any summer dens, nor seen any young. Hares were observed mating on April 27.

During the winter, hares seem to feed to a great extent on the Arctic willow *Salix arctica.* In summer, they have been observed feeding on *Parrya arctica* and *Oxyria digyna.* They seem to be very partial to the long fleshy roots, digging down several inches to procure them.

A pelage change is apparent during the summer, but some individuals seem to remain white. First evidence of moulting was observed on June 21. In July, both white and grey hares were seen in the same locality, and on August 1 a large grey male was collected. It was feeding on the same hillside with a completely white hare. The one in the white pelage was extremely wary, and for that reason it was not possible to collect it.

Observations: April 18 (1); 22 (2); 27 (3); May 18 (1); 20 (1); 21 (3); June 2 (2); 8 (1); 11 (1); 13 (1); 21 (2); 30 (2); July 30 (1); 31 (1); August 1 (2).

Specimens in National Museum of Canada:
3 adult males, 1 adult female.

Measurements (in mm.):
Males: total length, 631, 596, 628; tail, 63, 55, 98; hind foot, 153, 155, 149.
Female: total length, 610; tail, 55; hind foot, 170.

Peary Caribou. *Rangifer pearyi* Allen

These caribou were quite common on Mould Bay Peninsula in 1949. Handley reported 50 animals in sight at one time, as they fed along the low hills in the vicinity of Manson Point. In 1952 the writer found that there was a definite decrease in their numbers and that areas previously supporting herds were untouched. Caribou observed from April 25 to June 30 totalled 68, and in 1949 during the same months and at the same areas 171 were counted.

The writer has never seen any young at Prince Patrick Island, but a female with a fully developed fœtus was killed on May 12, 1949.

Observations: April 16 (8 noted by R.C.A.F. at head of bay); 22 (8 tracks crossed bay); May 13 (6); 20 (3); 27 (4); 30 (several sets of tracks); June 2 (10 sets of tracks); 11 (3 bulls with antlers about 17 inches high); 18 (3); 19 (2); 21 (7, moulting heavily); 22 (5); 27 (11); 28 (5); 29 (2); 30 (10); July 1 (3); 3 (4 winter pelage mostly shed); 4 (5); 6 (7); 18 (tracks on beach, 3 adults, 1 calf); August 16 (3 tracks of 3 adults and 1 calf).

Specimens in the National Museum of Canada:
3 adult males, 1 adult female.

Measurements (in mm.):
Males: total length, 1,575, 1,760, 1,600; tail, 120, 128, 130; hind foot, 510, 528, 493.
Female: total length, 1,054; tail, 133; hind foot, 465.

White-faced Musk-ox. *Ovibos moschatus* Lydekker

Herds of musk-ox were regularly observed feeding on the grassy meadows and vegetated slopes of Mould Bay peninsula from March 16 to September 1. The number of individuals observed during a day's travel varied from two adult males to a total of fifty-six animals in three herds.

Musk-ox were observed during the field excursions away from the weather station, and on several occasions animals were seen near the station area. The dogs were kept tied during the summer, and the musk-ox were able to graze in the nearby "Station River Valley" without being molested. However, it was difficult to approach a grazing herd without the dogs, since their presence tended to prevent the musk-oxen from stampeding. As bird collections were made on these field trips as well as observations on musk-ox herds, it was not practicable to have the dogs along. Hence, the writer was able to separate only adult bulls, yearlings, and calves in the herds observed. The remaining individuals, the females and sub-adult bulls, could not be segregated.

In all herds that were near enough to observe, there was at least one adult male present. Lone bulls were not observed before June 18, and then only on three occasions.

Young calves were more common than in 1949, and on July 18 seven were seen in a herd of seventeen individuals. One female appeared to be followed by two young, possibly twin calves. The first young were seen on May 11, in a herd of twenty-seven. These animals were very wary and would not allow approach beyond two hundred yards without running away. The writer assumed the young to be several weeks old, since they had no difficulty keeping up with the herd as they galloped over the snow-covered meadow and disappeared over the ridge a mile away.

Handley in 1949 reported seeing a very young calf on May 2. No young were seen before this date. The writer was surprised to note the adult bulls displayed a great deal of concern for the young calves. On one occasion a herd was observed where the calf, apparently too young to recognize the characteristic circle of defence as a safety zone, wandered about on the fringes of the herd. Two large bulls were present in this particular group, and both of them seemed to take turns at bunting, pushing, and kicking the calf back into the herd where it belonged.

During the summer the musk-ox moults its dense woolly underfur. This was evident in mid-June when the animals were seen with great mats of wool dangling from the long outer pelage. At this time, the musk-oxen have a great desire to rub themselves against rocks, mounds of earth, or any projecting object that is available. These areas are always marked by the moulted wool lying about.

In summer, musk-oxen wander over the vegetated areas feeding as they pass, but they seem to have definite food preferences. Mr. Bruggeman has kindly allowed me to quote part of his notes recording the feeding habits of musk-oxen:

> "June 13—They had been feeding mainly on a species of grass, which was showing much fresh growth and which they had eaten so close to the ground I could not make out what it is. (The grass was later found to be *Puccinellia angustifolia.*) Stands of *Alopecurus alpinus*, even where it grew among the other grass, seemed not to be touched at all. The close feeding of these animals probably prevents the willows (*Salix arctica*) from making better growth and also from setting seed. Only near the station, where the dogs kept the animals away, can we find willows that seeded freely last year. *July 29.* On the *Scheuchzeri* marshes (along the east shore of Mould Bay Peninsula, north of Manson Point) which I had passed in the morning, I had the opportunity of making observations on the feeding habits of musk-oxen. They appear to prefer willows to everything else and usually eat them right down to the ground,

> frequently pulling them up altogether. A herd had tramped through a thick stand of cotton grass (*Eriophorum scheuchzeri* and *E. angustifolium*) without touching any of it, but had neatly clipped a large patch of *Dupontia fisheri*. As a rule these animals appear to prefer the different species of *Poa* (and *Puccinellia angustata*) to other grasses."

The only evidence of fighting between bulls was noted on August 23. A herd of thirteen animals, including two bulls, was observed feeding in a grassy valley. One bull, slightly larger than the other, moved so that he kept himself between the other bull and the herd. They grazed quietly until a stray breeze carried human scent to the herd. The large bull became very agitated. He snorted, and shaking his massive head he pawed the ground and rubbed the maxillary region of his face against his fore legs. These actions seemed to upset the herd, and they immediately grouped in the protective formation, while the bulls, both assuming the aggressive attitude described above, remained in their positions. The dominant bull, snorting occasionally, moved closer to the herd. At his approach, several of the herd broke away from the main group and began to gallop towards a low hill. Once the formation was broken, the whole group stampeded. The large bull wheeled madly about to face the other bull, which was making for the main group, and charged him. The dominant bull struck his fleeing rival a raking blow in the flank which nearly knocked him over. The pursuit was continued around the herd, which by this time had grouped again at the summit of a low hill; the grouped animals took great care to keep out of the way. The aggressor bull seemed to be of superior strength and fighting experience. Finally he buried a long curved horn in the shaggy side of his adversary and proceeded to gore him as they ran. At last, the smaller bull galloped off, and the tyrant strode back to his harem with some of his rival's hair and wool trailing from his horns. He quietly approached and smelled several of the animals in the herd and then turned slowly away to feed. Evidently the vanquished bull suffered little injury, for eventually the whole group moved down into the grassy valley again and began feeding, as they were when the writer came upon them.

Observations: April 16 (10 at head of bay reported by R.C.A.F.); May 11 (27, including 2 calves, reported by station personnel; these animals were very wary, stampeded and ran for several miles); May 19 (herd of 26, 2 miles ESE of station, contained 5 adults and 2 young calves; this group was very wary, stampeded and climbed a steep 250-foot slope, deeply snow-covered, then ran on for several miles); May 20 (56 in three herds—the same 26 as observed on May 19; 20 others too distant to sex; 10 more among which were 2 bulls and 1 young calf); May 26 (17 including 3 yearlings); May 27 (4); May 28 (23:4—1 adult male, 3 others; 19 including 4 young calves, 3 yearlings, 1 adult bull, 2 individuals believed to be old cows, with very long, downcurving flat horns); May 29 (4, including 1 adult male); May 30 (30, two herds made up of 10 and 20 respectively—too distant to segregate; one calf in first herd—4 in second); June 1 (4, including 1 adult male); June 2 (4); June 8 (27, two herds made up of 11 and 16 respectively with 2 calves in last herd); June 13 (21 at head of bay); June 18 (51, in three herds—27 including 2 young calves, 3 adult males (all adults moulting heavily); 3 (all adult males); 21, too distant to sex);

June 21 (31 in three herds—23 including 2 young calves following 1 cow; 3 adult males; 5 too distant to segregate); June 22 (24 observed by station personnel); June 24 (32 observed by station personnel); June 28 (31); June 29 (31); June 30 (15, including 7 calves); July 2 (35, in two herds—31, including 5 calves; 4 adult males, animals nearly through molt); July 6 (13 including 5 calves); July 8 (17, including 7 calves); July 17 (12 in two herds, including 2 adult males and 3 calves); July 20 (2 adult males); July 28 (24); August 21 (20 in two herds of 7 and 13 respectively); September 1 (2 bulls).

Specimens in National Museum of Canada:

1 adult male, 1 adult female, 1 additional skull.

Measurements (in mm.):

Male: total length, 2,007; tail, 140; hind foot, 430.
Female: total length, 1,091; tail, 150; hind foot, 425.

SYSTEMATIC LIST OF BIRDS

During the two field seasons at Mould Bay twenty-four species of birds were recorded. Until this time, no systematic biological study had been made at Prince Patrick Island; the observations and collections by explorers visiting the Island are the only source of information. In the present study, several species are recorded that previously were not known to occur on Prince Patrick Island.

Appreciation is extended to W. Earl Godfrey, ornithologist, National Museum of Canada, for checking the identification of the birds recorded here.

It is expected that a report on the taxonomy of the various bird and mammal forms occurring on Prince Patrick Island will be prepared by Charles O. Handley, Jr., Smithsonian Institution, Washington, D.C.

Red-throated Loon. *Gavia stellata* (Pontoppidan)

First observed on June 22. One pair nested and raised a single young on a small pond about half a mile northeast of the weather station. In this area a series of ponds were situated near where the loons had their nest, and it is interesting to note that the adults moved the downy young from one pond to the other during the summer. A few of these were connected by shallow drainage depressions, but one basin, lying 200 feet from any other and without a connecting waterway, was periodically visited by the adult loons and the flightless young. These ponds were beginning to freeze before the immature were able to fly. Red-throated loons probably breed on the lakes at the head of Mould Bay. No nests were found in this vicinity, but several pairs were seen on each visit to the area.

Observations: June 23 (2); 24 (1); 25 (2); 26 (4); 27 (1); 28 (2); 29 (1); 30 (2); July 2 (1); 3 (3); 4 (4); 5 (2); 6 (3); 7 (5); 8 (2); 9 (4); 10 (5); 11 (2); 12 (1); 14 (2); 15 (3); 16 (1); 17 (1); 24 (1); 28 (1); August 3 (2); 4 (1); 7 (3); 8 (1); 10 (6, 1 young); 11 (1); 12 (2); 13 (1); 14 (1); 18 (3, young half-grown); 19 (2); 20 (4); 21 (1); 23 (3); 27 (3); 30 (1); 31 (2); September 1 (2).

Specimens collected:

1 adult male.

Brant. *Branta bernicla* (Linnaeus)

Both the Atlantic and black brant are common at Mould Bay during the summer, the latter arriving a few days earlier than the former. The spring of 1952 was much milder than 1949, and when the brant arrived this time, the small tundra ponds were already partly open and their grassy edges offered an ample supply of food.

During the summer the writer kept careful notes on these brant. Following is a summary:

When the brant first arrive at Mould Bay, the ground is mostly snow covered. There seems to be a few days difference between the arrival dates of the two forms; black brant arrived June 6, Atlantic brant on June 12. From the past summer's observation the writer believes the black brant to be more numerous. The restricted feeding grounds in early spring force the two forms to frequent the same habitats. Later in the season, they may still be found together in the same areas, but there usually is a great deal of squabbling, and they keep out of each other's way. There is a marked antipathy, not confined to one form or the other, toward newcomers to a group. The pugnacious attitude is general, and usually the new ones are driven away, at least from the immediate company of the first group. Sometimes this pursuit continues in the air, the birds wheeling and turning with surprising grace. Loud honkings usually accompany these activities. Several times the writer has seen them strike one another and attempt to bite while in flight.

During the summer the writer found three nests of black brant, one containing five eggs on June 13, and two others with four eggs each. The five-egg nest was destroyed before the eggs hatched, and I believe the long-tailed jaegers were responsible, since there was a pair nearby when I flushed the incubating brant from its nest. One of the four-egg nests was destroyed by predators, probably long-tailed jaegers. Five other nests were discovered which had shared the same misfortune. No nests of Atlantic brant were located. Each mated pair seemed to be of the same form, and no inter-breeding was evident. In 1949, however, the writer found a brant's nest containing three eggs where the incubating female seemed to be a typical black brant while the male was a great deal lighter below and very much resembled the Atlantic brant.

The writer could not find any nesting habitat preference. Some nests were situated on the dry almost barren polygon soil of a hillside; others were placed in the grass and moss at the edge of a tundra pond. Two were found in quite unusual locations—one on a low mossy promontory extending 50 feet out into a small lake, which probably had been a deserted red-throated loon's nest. The nest had been built up with moss so that the eggs were just above water-level, and then it had been lined with down and a few breast feathers. The other was placed among the scree almost at the edge of the water of Mould Bay. It was so close to the water's edge that waves breaking over the beach must have splattered it with spray. This nest had been destroyed before the writer found it. Downy young brant were first seen on July 24. As soon as the young are strong enough for overland travel, the adults tend to move them to the bay where the greater expanse of open water offers greater safety. This is true also of the flightless birds during the moult; very few of them spend this period on the lakes and ponds. The vegetated slopes along the shore of Mould Bay Peninsula provide sufficient grazing, and in favoured locations as many as 425 individuals including both forms were counted.

Two specimens were collected on August 23, and both had been feeding exclusively on the fruiting stems of *Juncus biglumis.*

Specimens in National Museum of Canada:

7 adult males, 8 adult females, 1 juvenal female.

Old-squaw. *Clangula hyemalis* (Linnaeus)

Quite common; numbers observed were comparable to those made in 1949. Probably breeds, but no nests or young were seen.

Observations: June 15 (2); 17 (8); 20 (6); 23 (5); 24 (2); 25 (5); 26 (1); 29 (5); 30 (3); July 1 (5); 4 (1); 5 (8); 8 (5); 9 (19); 10 (11); 11 (30); 12 (48); 13 (3); 14 (20); 15 (24); 23 (11); August 18 (7, 1 adult male and 6 adult females).

Specimens in National Museum of Canada:

8 adult males, 1 adult female.

King Eider. *Somateria spectabilis* (Linnaeus)

King eiders were seen regularly throughout the season at Mould Bay but much less commonly than in 1949. No nests were found, but several broods of young were seen during the summer. The writer was surprised to note a partial albino female at the same pond where a very similarily marked bird of the same sex was observed in 1949.

Observations: June 11 (5, all males); 15 (4, 2 pairs); 16 (8); 17 (13); 18 (1); 19 (3); 20 (4); 21 (1); 22 (4); 23 (24); 24 (5); 25 (14); 26 (4); 27 (4); 28 (1); 29 (4); July 1 (1).; 2 (2); 3 (8); 4 (2); 5 (1); 7 (2); 8 (2, both female, one partial albino); 9 (1); 10 (6); 11 (20 at Snowpatch Point); 28 (10); 29 (4); 30 (7, female and 6 downies); 30 (8: 4 adult females, 4 downies); 31 (15, 3 adult females, one accompanied by 12 downies); August 4 (1); 5 (7, adult females, 6 downies about the size of teal); 5(32); 8 female with 7 young); 9 (14, 8 adult females, 6 half-grown young); 19 (5, female and 4 young, harassed by 2 ringed seals); 20 (3); 23 (5); 27 (1); 30 (4); 31 (40).

Specimens in National Museum of Canada:

11 adult males, 10 adult females, 1 downy male, 6 immatures.

American Rough-legged Hawk. *Buteo lagopus* (Gmelin)

A single pair was found nesting in 1949; the nest was destroyed before the young were fledged, and the adults deserted the area. No specimens were collected, and none were seen in 1952.

Rock Ptarmigan. *Lagopus mutus* (Montin)

One of the commonest birds at Mould Bay in 1952, probably three times more abundant than in 1949. In the last two weeks of May, flocks totalling thirty to eighty-nine birds were seen. Then when the males had chosen their territories, their belching or croaking calls proclaiming ownership could be heard from every ridge and hillside. Males in immaculate white plumage displayed widely spread jet black tails and glowing red combs before flocks of females, or fought rival males trespassing on their chosen area. The vegetated patches of snow-free ground were linked together with a lace-work of ptarmigan tracks. Ptarmigan seemed to be everywhere.

By May 27, the females were noticeably speckled with brown, and by June 6 they were completely brown. Males began to show signs of moulting by mid-June, and the first completely brown male was noted on July 2. Although many of the males still retain most of their winter plumage at this time, they have become so dirty from dusting themselves that a colour change is hardly necessary. Three nests were found, one within 200 yards of the station buildings. The clutch size varied from seven to eleven eggs. Several broods of young were seen also. Where the ptarmigan nests were found, the mate of the incubating female was always nearby. These males always displayed marked anxiety when the writer was near the nest, particularly until the hen left the eggs. One female allowed herself to be lifted from her nest of eleven eggs without showing any apparent fear. On several occasions the writer saw cock ptarmigan drive long-tailed jaegers away from the nest area, or from the hen with a brood of downy young.

In early August when the young were nearly fully grown, large flocks were commonly seen; once 101 individuals were observed in one day.

During the summer the crop contents of all immature ptarmigan examined contained mostly the leaves and red bulblets of *Saxifraga cernua*, also some insects, insect larvae, and spiders. The crop contents of four adult ptarmigan taken on September 15 is as follows:

Saxifraga caespitosa (capsules and fruiting heads)—75 per cent
S. oppositifolia (capsules) — 8 per cent
Salix arctica (buds and small twigs) — 8 per cent
Papaver radicatum (unripe capsules) — 7 per cent
Draba Bellii (unripe pods) — 2 per cent
Stellaria longipes var. (a few leaves and one flower)
Ranunculus sulphureus (1 fruiting head)
Saxifraga cernua (1 leaf)

Observations: April 27 (4 sets of tracks); 30 (5); May 1 (3); 2 (1); 5 (1); 6 (6); 7 (5); 8 (2); 9 (1); 10 (3); 11 (16); 12 (1); 13 (17); 14 (4); 15 (30); 16 (12); 19 (4); 20 (84); 21 (25); 22 (6); 23 (19); 24 (3); 25 (29); 26 (6); 27 (40); 28 (46); 29 (62); 30 (89); 31 (41); June 1 (28); 2 (12); 3 (8); 4 (8); 5 (4); 6 (5); 7 (3); 8 (4); 9 (5); 10 (8); 11 (12); 12 (4); 13 (24); 14 (7); 15 (28); 16 (4); 17 (12); 18 (7); 19 (7, 1 nest with 10 eggs, in slight depression between polygons—sparsely lined with feathers and grass); 20 (3); 21 (10); 22 (2); 23 (5); 24 (7); 25 (8); 26 (4); 27 (2); 28 (3); 29 (5); 30 (5); July 1 (3); 2 (5); 3 (2); 4 (4); 5 (2); 6 (15, nest with 11 eggs, 8 already hatched, same habitat as first nest); 7 (13, hen with 10 chicks); 8 (3); 9 (15, hen with 10 chicks); 10 (2); 11 (12); 12 (2); 13 (1); 16 (13, hen with 12 chicks); 17 (1 nest with 7 eggs, located on steep, rocky hillside among grass tussocks); 22 (9, adult pair with 7 chicks, flying well); 28 (10); 29 (1); August 2 (2); 3 (10); 4 (12, 1 female with 9 chicks, one other with a single young); 5 (19); 8 (101—also 1 nest containing 11 egg shells (hatched) and 1 infertile egg); 10 (53); 12 (44); 14 (74); 19 (14); 20 (7); 22 (34); 24 (8); August 25 (5—half white).

Specimens in National Museum of Canada:

23 adult males, 16 adult females, 9 immatures.

[*Black-bellied Plover. Squatarola squatarola* (Linnaeus)

Hypothetical. The writer observed a large shore bird feeding on the wet tundra in 1949. It was very wary and flew off before it could be identified with certainty, but its characteristic call confirmed the writer's belief that it was a black-bellied plover. It was not observed again in 1949, nor others of its kind in 1952.]

Knot. *Calidris canutes* (Linnaeus)

Quite rare. Found breeding at Mould Bay in 1949, observed only once in 1952, on June 2.

Specimens collected in 1949 only:
2 adult males, 2 immatures.

Purple Sandpiper. *Arquatella maritima* (Brünnich)

Not observed in 1952, Handley collected one specimen in 1949.

Pectoral Sandpiper. *Erolia melanotos* (Vieillot)

Not observed in 1952. One specimen taken by Handley in 1949.

White-rumped Sandpiper. *Erolia fuscicollis* (Vieillot)

Not observed in 1952. One specimen taken by Handley in 1949.

Baird's Sandpiper. *Erolia bairdii* (Coues)

Rare in 1949, found commonly at Mould Bay in 1952 and believed to breed in that area. No nests were found, but the behaviour of the adults suggested nesting, and several specimens were taken in breeding condition.

Observations: June 3 (1); 11 (2); 15 (2); 18 (3); 21 (2); 22 (2); 23 (5); 24 (5); 25 (3); 26 (2); July 2 (4); 4 (3); 8 (3); 9 (1); 11 (2); 20 (4); August 27 (5 immatures).

Specimens in National Museum of Canada:
5 adult males, 1 immature male, 3 adult females.

Sanderling. *Crocethia alba* (Pallas)

Found to breed commonly in 1949, observed only four times in 1952.

Observations: June 11 (2); 15 (1); July 3 (2); August 27 (2 immatures).

Specimens in National Museum of Canada:
4 adult males, 3 adult females, 5 immatures.

Red Phalarope. *Phalaropus fulicarius* (Linnaeus)

Rare in 1949, and not observed in 1952 until August 18. No evidence of breeding was noted. Ten days later, a large flock of migrating red phalaropes were seen feeding along the shore of Mould Bay in the lea of the cliffs about two miles north of the station. They were still present in fairly large numbers on August 30, but the bay was quickly freezing and many of the birds feeding in the water, already thick with ice crystals, became coated with ice. The lower tail coverts seemed to collect most of the ice, and many individuals finding themselves in such a condition would attempt to preen the ice away. This seemed to be futile, and the plumage seemed to become water-logged. The unfortunates then fluttered to the ice-covered beach where some of them soon became frozen to the ice. Glaucous gulls made a continual patrol of the beach and fared well while the phalaropes were present.

Observations: August 18 (1); 27 (9); 28 (1,000 to 1,500); 29 (1,000); 30 (300 to 400); 31 (300); September 1 (200 to 300).

Specimens in National Museum of Canada:

1 immature male, 1 immature female, 2 wings (from badly decayed specimen found in 1949).

[*Pomerine Jaeger. Stercorarius pomarinus* (Temminck)

Hypothetical. On separate occasions Handley and the writer saw a jaeger believed to be this species.]

Long-tailed Jaeger. *Stercorarius longicaudus* Vieillot

The writer found long-tailed jaegers to be common at Mould Bay on each visit to that area. Several nests were found in 1949, and one in 1952. Two eggs were found in each nest except one, which contained one egg.

Long-tailed jaegers constantly patrol the tundra and undoubtedly find many nests of brant, eiders, and other birds. Eight brant nests were found in 1952, and five of these were destroyed before the eggs hatched. Since evidence of foxes was very seldom noted during the summer, it was believed that the jaegers were responsible for most of the nest destruction and young bird predation at Mould Bay.

Observations: June 5 (2); 8 (3); 10 (5); 11 (3); 12 (5); 13 (19); 14 (10); 15 (12); 16 (4); 17 (14); 18 (7); 19 (3); 20 (3); 21 (5); 22 (2); 23 (4); 25 (1); 26 (5); 27 (2); 28 (2); 29 (4); 30 (16); July 1 (2); 2 (5); 3 (3); 4 (13); 5 (3); 6 (5); 7 (7); 8 (3); 9 (4); 10 (1); 11 (11); 12 (4); 13 (3); 14 (2); 15 (3); 16 (3); 17 (2); 18 (2); 19 (1); 20 (2); 21 (1); 22 (1); 23 (2); 24 (4); 25 (2); 26 (3); 27 (1); 30 (2); 31 (1); August 2 (1); 3 (1); 4 (7); 5 (2); 8 (4); 9 (2); 10 (1); 11 (2); 12 (1); 13 (1); 14 (2); 17 (1); 18 (2).

Specimens in National Museum of Canada:

8 adult males, 3 adult females, 3 immatures.

Glaucous Gull. *Larus hyperboreus* Gunnerus

Glaucous gulls were observed regularly throughout both summers at Mould Bay. They arrive early in June, even before the shore leads appear, to reoccupy the nesting ledges along the cliffs. No colonies were found; the nests were placed singly or in pairs in favourable locations on the few ledges that are suitable. Although several nests with eggs or young were located, no full-fledged young were seen. During their stay at Mould Bay, glaucous gulls along with long-tailed jaegers haunt the station refuse heaps for food. They also feed upon any animal carcasses available, and on several occasions adult snow buntings have been found in the stomachs of glaucous gulls.

Observations; June 2 (5); 3 (3); 4 (2); 5 (2); 6 (2); 7 (4); 8 (3); 9 (3); 10 (4); 11 (2); 12 (2); 13 (5); 14 (2); 15 (5); 16 (2); 17 (4); 18 (1); 12 (2, nest with two eggs on small spur on "Gull Cliffs" (about two miles up Bay from station), nest placed in centre of tuft of grass, larger of two adults very aggressive); 20 (1); 21 (2); 22 (2); 23 (4, 2 nests at head of Bay, one contained two eggs, other unfinished); 24 (5); 25 (3); 26 (3); 28 (2); 29 (2);

30 (3); July 1 (1); 2 (2); 3 (1); 4 (1); 5 (1, one of the eggs in nest No. 1 has disappeared); 6 (1); 7 (1); 9 (4); 10 (1); 11 (3); 12 (1); 13 (2); 14 (2); 15 (3); 16 (3); 17 (2); 18 (1); 19 (2); 21 (1); 22 (1); 23 (3, young in nest No. 1 hatched, adults much more aggressive); 24 (1); 28 (2); 30 (3); August 4 (2); 8 (3); 9 (2); 10 (1); 12 (4); 13 (1); 14 (1); 18 (1); 19 (2); 20 (1); 21 (2); 22 (1); 23 (3); 24 (3); 27 (2); 29 (1); 30 (4); 31 (4); September 1 (2).

Specimens in National Museum of Canada:

8 adult males, 1 immature male, 8 adult females.

Ivory Gull. *Pagophila eburnea* (Phipps)

Eight ivory gulls were recorded by McClintock during his travels on Prince Patrick Island in search of Sir John Franklin. He reports seeing nests at the Polynian Islands and at Cape Krabbe; one nest contained a single egg (*Arctic Ice Travel* by McClintock, p. 47). No ivory gulls were recorded from the Mould Bay area on 1949 and 1952 expeditions.

[*Arctic Tern. Sterna paradisaea* Pontoppidan

Hypothetical. On August 29, Mr. Bruggemann observed two slender long-winged white birds, with forked tails, pass the laboratory window. While trying to identify them with the aid of binoculars, he noted about twenty others flying about over the bay shore. Visibility was poor in blowing snow, so certain identification was not possible. However, the writer believed the birds to be migrating Arctic terns—possibly carried to Mould Bay by the unfavourable high wind.]

Snowy Owl. *Nyctea nyctea* (Linnaeus)

Lemmings were abundant in 1949, and snowy owls were seen quite commonly throughout the season, though they seemed to be present in greater numbers during the latter part of the summer and autumn. Seven of these owls were counted as they perched on grassy hummocks of the "Station River" Valley.

In 1952, snowy owls were seldom seen and were exceedingly wary. On June 22, one was seen feeding upon the still warm carcass of a male king eider. The head and breast were partly eaten, and at my approach the owl attempted to carry it away. After a very laboured flight of fifty yards or so, it dropped the duck carcass and flew off to a nearby ridge.

Observations: May 2 (1); June 2 (2); 11 (1); 22 (1); 25 (1); July 8 (1); 24 (1); 28 (1).

No specimens were taken.

Horned Lark. *Eremophila alpestris* (Linnaeus)

Not previously recorded from Prince Patrick Island. Found to frequent the well-drained hillsides, and seen to feed along the edges of the small tundra ponds, presumably searching for larvae of insects living in the water and wet moss. No nests were found, but immatures still being fed by the adults were seen in mid-July.

Observations: June 30 (1, believed to be a horned lark); July 2 (1); 7 (1); 8 (4); 10 (1); 11 (6); 13 (1); 28 (2).

Specimens in National Museum of Canada:

2 adult males, 1 immature male, 2 adult females.

Willow Warbler. *Phylloscopus borealis* (Blasius)

Very rare. A single adult male in National Museum of Canada was taken at Mould Bay in 1949. The bird was very fat and in breeding condition. It was feeding with a flock of snow buntings on a damp hillside near the station. No others have been recorded.

Raven. *Corvus corax* Wagler

Observed fairly regularly throughout both visits to Mould Bay. No evidence of nesting in 1949. Weather personnel reported ravens nesting in 1951 on the 25- to 30-foot sandstone(?) chimney that had been used by the American rough-legged hawks in 1949. This nesting ledge has fallen, and the site was not occupied in 1952. One immature and one adult raven were seen on August 8. No specimens were collected.

Observations: May 1 (3); 2 (2); 4 (1); 6 (3); 7 (4); 8 (6); 9 (1); 15 (1); 21 (2); 22 (1); June 2 (2); 8 (1); 17 (1); 21 (1); 25 (1); July 6 (2); 28 (1); August 8 (2); 12 (1); 17 (1); 24 (2); 27 (2); 30 (1).

Hornemann Redpoll. *Acanthis hornemanni* (Holboell)

Very rare. Handley observed one in 1949. In 1952 on June 2 the writer heard two calling as they passed overhead and disappeared into a steep rocky ravine at the head of Mould Bay. On August 12, Mr. Bruggemann saw a flock of ten; these appeared to be mostly immatures. No specimens were taken.

Lapland Longspur. *Calcarius lapponicus* (Linnaeus)

A common breeding bird at Mould Bay.

Observations: June 2 (2); 3 (9); 4 (14); 5 (4); 6 (2); 7 (4); 8 (4); 9 (6); 10 (8); 11 (8); 12 (8); 13 (6); 14 (8); 15 (16, first nest contained six eggs); 16 (10); 17 (14); 18 (7, mostly singing males); 19 (5); 20 (4); 21 (5); 22 (1); 25 (2); 28 (2); 29 (6); 30 (6); July 1 (6, males sing only occasionally); 2 (14, adults carrying food); 3 (15); 4 (20); 5 (3); 6 (2); 7 (8); 8 (20, young flying well); 9 (2); 10 (1); 11 (4); 12 (1); 16 (1); 20 (1); 22 (1); 23 (10); 24 (20); 25 (10); 26 (8); 29 (10); 30 (12); 31 (11); August 1 (35, mostly immatures flocking with immature snow buntings); 2 (43); 3 (2); 4 (1); 5 (20); 6 (2); 7 (11); 8 (43); 9 (1); 10 (40); 12 (4); 13 (2); 14 (5); 16 (23); 17 (2); 18 (14); 20 (4); 21 (2); 22 (2); 23 (21); 24 (2); 25 (11); 27 (17); 28 (1); 30 (14); September 1 (2).

Specimens in National Museum of Canada:

7 adult males, 5 adult females, 7 immatures.

Eastern Snow Bunting. *Plectrophenax nivalis* (Linnaeus)

The most common breeding bird at Mould Bay. Observed almost daily from the time of its arrival in the latter part of April to September 1.

The season's observations are much too lengthy to be included here. However, notes of special interest are set down.

Snow buntings began to arrive on April 23, and by mid-May the beautiful tinkling songs of the males could be heard continually floating down from their rocky perches in the ravines. Singing males were also common in the camp area; roofs of buildings and antenna masts were most favoured.

Most of the snow bunting population at Mould Bay is concentrated in the vicinity of the station. The birds have adapted themselves quickly to man's presence in the area and have taken advantage of the lumber caches, etc., for nesting sites. Eight nests were found, and several of these were placed in unnatural surroundings, i.e. in the centre of a discarded wire spool, in a box of pipe fittings, or in a tin can in the garbage heap. Others were found in rock crevices in rocky ravines and in piles of flat stones. The clutch size varied from five to eight, but six was the number most commonly found.

On June 21 adults were seen carrying food, and by August 7 immatures were seen frequently. The writer found that in one hour a female snow bunting made eleven trips to the nest of six half-grown young, while the male made only six. Usually he would fly to his look-out perch and sing after feeding the young, sometimes waiting until the female had made several trips before he flew off to forage. The main source of food seemed to be the insects living on the damp, mossy areas and at the edges of small ponds or streams.

By August 10 most of the immatures are out of the nest, the adult males still sing occasionally, but many of them are beginning to moult. Adult snow buntings, having raised the young, tend to retire to secluded rocky ridges and ravines to complete the moult. The first birds (believed to be immatures) in complete winter plumage were seen on August 9. Two flocks on September 1, totalling seventy birds, were the last snow buntings seen before the writer left Mould Bay.

Specimens in National Museum of Canada:

21 adult males, 7 adult females, 9 immatures.

LIST OF INVERTEBRATES

The writer is grateful to E. L. Bousfield, Invertebrate Zoologist, National Museum of Canada, for classifying marine and fresh-water invertebrate material collected at Mould Bay.

All marine invertebrates were taken with an improvised dredge similar to the one used at Alert, Ellesmere Island, in 1951 (See Report on Biological Investigations at Alert, N.W.T., by S. D. MacDonald, Bull. No. 128, Annual Report, National Museum of Canada). Because of the very soft, muddy bottom, the dredge had to be lightened to prevent its becoming loaded with silt. The specimens in marine localities were obtained by dredging near the shore where depths were less than 150 feet. With the makeshift equipment and very small boat that was available, work in deeper water was not possible. Particularly numerous in the marine material were opossum shrimps (e.g. *Mysis oculata*) and mud shrimps, amphipods and sea spiders, gastropods and bivalves, and starfish, brittle stars, and crinoids. When one takes into consideration the scarcity of occasions suitable for marine collecting and the difficulty in handling dredging gear in ice-laden Arctic waters, the numbers of specimens are surprisingly large. Further collections will contribute greatly to the knowledge of the distribution and ecology of the invertebrate fauna of the Canadian Arctic.

The invertebrate collection consists of some twenty-one lots of invertebrate animals numbering more than 5,800 specimens, and represents most of the animal phyla from the Porifera through the Protochordata. While the greater part of the collection is from marine localities, some specimens were taken from the skins and digestive tracts of avian and mammalian hosts. The lots of invertebrates were obtained from the following sources in the Mould Bay area:

L- 1	May 7	–From male rock ptarmigan.
L- 2	June 4	–From Arctic wolf.
L- 3	June 11	–From two Baird's sandpipers.
L- 4	June 12	–From Atlantic brant.
L- 5	June 14	–From Arctic wolf.
L- 6	June 18	–From king eider.
L- 7	June 18	–From stomach of king eider.
L- 8	June 23	–From glaucous gull.
L- 9	July 7	–From small tundra pond, mossy and grassy at edge, muddy bottom.
L-10	July 7	–From small tundra pond, mossy and grassy at edge, muddy bottom.
L-11	July 16	–Dredged in 40 feet.
L-12	July 23	–Dredged in 100 to 125 feet, muddy bottom.
L-13	July 26	–Dredged in 100 to 135 feet, muddy bottom.
L-14	July 27	–Dredged at 100 to 135 feet, muddy bottom.
L-15	July 28	–Dredged in 15 feet, muddy bottom.
L-16	Aug. 5	–From tundra pond, mossy edges.
L-17	Aug. 14	–Dredged in 75 to 100 feet, muddy bottom.
L-18	Aug. 19	–Dredged in 80 feet, muddy bottom, dense algae.
L-19	Aug. 23	–From stomach of ringed seal taken three miles N. of camp.
L-20	Aug. 23	–Found at edge of beach.
L-21	Summer	–Found along beach.

The material collected is listed by numbers of specimens (in parentheses) per lot per major subdivision of the animal kingdom;

Porifera:	L-14 (3); L-17 (1).
Coelenterata:	L-12 (2); L-14 (7); L-17 (8); L-18 (3); L-20 (1).
Platyhelminthes: (Cestoda)	L-2 (1+*); L-3 (several); L-4 (several); L-5 (1+); L-6 (1); L-8 (several).
Annelida: (Polychaeta)	L-11 (8); L-12 (3); L-13 (15); L-14 (9); L-15 (77); L-17 (27); L-12 (5); L-21 (several).
Arthropoda:	
Entomostraca:	L-9 (100+ Notostraca); L-10 (1000+ Cladocera and Copepoda). L-16 (100+ Notostraca).
Mysidacea:	L-11 (50+); L-12 (100+); L-13 (40); L-14 (16); L-15 (30); L-17 (1900+); L-18 (1); L-19 (500+*).
Amphipoda:	L-11 (2); L-12 (36+); L-13 (50+); L-14 (28+); L-15 (8); L-17 (70); L-18 (10).
Isopoda:	L-12 (10); L-13 (30+); L-14 (80+); L-17 (5+).
Cumacea:	L-13 (8); L-14 (1); L-15 (2); L-17 (2).
Decapoda:	L-12 (19); L-13 (37); L-14 (15); L-15 (21); L-17 (24); L-18 (7); L-19 (1).
Pantopoda:	L-12 (29); L-13 (30); L-14 (13); L-17 (114).
Insecta:	L-1 (100+ Mallophaga); L-3 (3 Mallophaga); L-7 (2+, Chironomidae); L-16 (several, Chironomidae).
Mollusca:	L-11 (17+); L-12 (104+); L-13 (138); L-14 (7); L-15 (214+); L-17 (186); L-18 (17+); L-21 (3).
Echinodermata:	L-12 (125+); L-13 (38+); L-14 (6); L-15 (9); L-17 (134).
Chaetognatha:	L-12 (1); L-13 (1).
Miscellaneous: (Bryozoa, Nemertea, Tunicata, etc.)	L-11 (2); L-12 (30+); L-13 (25+); L-14 (10+); L-15 (10+); L-17 (3+); L-18 (2).

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*+ sign indicates more than the number counted and/or fragments of specimens.

LIST OF FISHES

The writer is grateful to Vladimir Walters, Department of Biology, New York University, for his identifications and notes on the Mould Bay fishes. These notes were summarized by Mr. Walters from his paper on the fishes collected at Mould Bay and Alert, N.W.T., published in American Museum Novitates 1953, now in press.

In the present report are included notes on the abundance and coloration of various fishes.

Salvelinus alpinus (Linnaeus)

Arctic Charr. The first charr were discovered in a small tidal pool on the Station River delta on July 8. This pool was on the tidal flat, and apparently the fish had been left there when the tide receded. With this discovery, the gill nets (one 1½-inch, 4-inch) were moved from the deep water in the leads, where nothing was caught, to the shallow water of the tidal flats. After one tide, the smaller net contained two small charrs and 125 sculpins.

Because of the shifting ice-floes, it was necessary to maintain a constant watch over the nets. However, in spite of this, a fair collection of charr was obtained. The largest specimen, a 495 mm. female, weighing 2 pounds 3¾ ounces, was taken on July 10. It was noted that charr seemed to come up the bay with the rising tide, and on July 14 twenty-five of these fish were taken. This date seemed to be the peak of their abundance.

From his examination of stomachs of charr from Mould Bay, Walters states that the polar tomcod *Boreogadus saida* forms an important part of the summer diet and is the only identifiable species of fish in the stomachs of these charrs.

Boreogadus saida (Lepechin)

Polar Tomcod. First specimen found June 26, 1952; sixteen juveniles, 38 to 76 mm. long, collected with bottom dredge in 75 to 135 feet of water—from July 23 to August 18.

In life, these fish are a glistening silver with a delicate iridescent violet tint along the sides, which disappears at death. The silvery sheen is immediately lost when the specimens are immersed in formalin solution.

Anarhichas denticulatus Krøyer

Blue Cat-fish. On August 30, Mr. Bruggemann discovered this specimen washed up on the beach about 2½ miles from Mould Bay station. It was in excellent condition, and the writer was able to preserve it intact.

From Walters' notes: A male, 1,160 mm. in total length, stomach contained four spiny lumpsuckers. Fin counts and measurements are given. This specimen is compared with previous figures and descriptions of the species given by Russian, Danish, German, and United States workers, and it is shown that two kinds of fish are now referred to this species. It is not known whether the two kinds are of different species or whether the differences are due to sex, age, or other factors.

Lycodes pallidus Collett

Pale Eelpout. Eight juveniles were taken at Mould Bay in 100 to 135 feet of water on July 23-27. Four of these were parasitized by copepods of the family Lernaepodidae, belonging to the group of genera *Clavella—Clavellopsis*—Clavellisa—Clavellodes. Parasites were all immature, and because of this, further identification was not attempted.

Icelus bicornis (Reinhardt)

Two-horned Sculpin. Two adult females and seven juveniles.

Myoxocephalus quadricornis (Linnaeus)

Four-horned Sculpin. Sculpins were greatly in the majority of all fishes taken at Mould Bay. They were most common on the soft muddy bottom where melt streams emptied into the bay. When gill nets were set along the shore, sculpins became so entangled in the meshes that in a short time the catching properties of the nets were reduced to nothing. One hundred and twenty-five were taken from a 75-foot inch-mesh gill net after it had been set six hours. The only solution to the problem was to raise the net about one foot above the bottom. This did not appear to interfere with the catch of charr since the greatest proportion of these fish seemed to get caught in the upper half of the net.

Eumicrotremus spinosus (Müller)

Spiny Lumpsucker. Three postlarvae were taken at 80 feet with bottom dredge on August 18 and four adults from stomach of *Anarhichas denticulatus.*

LIST OF PLANTS

Determined by A. E. Porsild

Equisetum variegatum Schleich
Alopecurus alpinus Sm.
Arctophila fulva (Trin.) Rupr.
Calamagrostis chordorrhiza Porsild (New to the Arctic Archipelago).
Dupontia Fisheri R. Br.
Hierochloe pauciflora R. Br.
Phippsia algida (Sol.) R. Br.
Pleuropogon Sabinei R. Br.
Poa ? abbreviata R. Br.
P. arctica R. Br.
P. Hartzii Gand.
Puccinellia phryganodes (Trin.) Scribn. & Merr.
Trisetum spicatum (L.) Richt.
Carex Bigelowii Torr.
C. ursina Dew.
Eriophorum angustifolium Honck.
E. Scheuchzeri Hoppe
Juncus biglumis L.
L. confusa Lindeb.
L. nivalis (Laest.) Beurl.
Salix arctica Pall.
Oxyria digyna (L.) Hill
Arenaria rubella (Wahl.) Sm.
Cerastium arcticum Lge.
C. Beeringianum Cham. & Schlecht.
Cerastium Regelii Ostf.
Melandrium apetalum (L.) Fenzl. ssp. *arcticus* (Fr.) Hult.
Stellaria ciliatosepala Trautv
Ranunculus hyperboreus Rottb.
R. nivalis L.
R. Sabenei R. Br.
R. sulphureus Sol.
Papaver radicatum Rottb.
Papaver
Braya purpurascens R. Br.
Cardamine bellidifolia L.
C. pratensis L. var. *angustifolia* Hook.
Cochlearia officinalis L. var. *groenlandica* (L.) Gel.
Draba Bellii Holm
D. cinerea Adams
D. lactea Adams
D. oblongata R. Br.
D. subcapitata Simm.
Eutrema Edwardsii R. Br.
Parrya arctica R. Br.
Saxifraga caespitosa L.
S. cernua L.
S. flagellaris Willd.
S. foliolosa R. Br.
Saxifraga Hirculus L.
S. ? nivalis L.
S. oppositifolia L.
S. rivularis L.
S. tenuis (Wahlenb.) Sm.
Dryas integrifolia M. Vahl.
Potentilla hyparctica Malte
P. Vahliana Lehm
Astragalus alpinus L.
Crepis nana Richards
Erigeron eriocephalus J. Vahl
Petasites frigidus (L.) Fr.
Taraxacum hyparcticum Dahlst.
T. lacerum Greene
T. phymatocarpum J. Vahl

LIST OF LICHENS

Collected by S. D. MacDonald, 1952
Determined by I. MacKenzie Lamb.

- *Alectoria nigricans* (Ach.) Nyl.
- *Alectoria ochroleuca* (Ehrh.) Nyl.
- *Caloplaca elegans* (Link) Th. Fr.
- *Caloplaca subolivacea* (Th. Fr.) Lynge
- *Cetraria crispa* (Ach.) Nyl.
- *Cetraria cucullata* (Bell.) Ach.
- *Cetraria hiascens* (Fr.) Th. Fr.
- *Cetraria tilesii* Ach.
- *Cladonia pyxidata* (L). Fr., var. *pocillum* (Ach.) Flot.
- *Cladonia pleurota* (Flk.) Schaer.
- *Crocynia neglecta* (Nyl.) Hue
- *Dufourea ramulosa* Hook.
- *Lecanora epibryon* Ach.
- *Lecidea ramulosa* Th. Fr.
- *Ochrolechia frigida* (Sw.) Lynge
- *Parmelia alpicola* Th. Fr.
- *Parmelia omphalodes* (L.) Ach.
- *Peltigera aphthosa* (L.) Willd.
- *Peltigera canina* (L.) Willd. and var. *rufescens* (Weis) Mudd
- *Peltigera leucophlebia* (Nyl.) Gyeln.
- *Physcia muscigena* (Ach.) Nyl.
- *Stereocaulon paschale* (L.) Hoffm., var. *alpinum* (Laur.) Mudd
- *Stereocaulon rivulorum* H. Magn.
- *Thamnolia vermicularis* (Sw.) Ach. and var. *taurica* (Wulf.) Schaer.

LIST OF FOSSILS

Rept. K. I. 1953/54.

Determinations and notes by Dr. J. A. Jeletzky

G.S.C. Cat. No. 23002

Locality: "Mould Bay, N.W.T., picked up on top of hills overlooking bay, 3 miles north of station."

- *Belemnites* (*Oxyteuthis* or *Cylindroteuthis*) sp. indet.
- *Aucella* cf. *fischeri* (d'Orb.)
- *Aucella* cf. *trigonoides* Lahusen
- *Aucella* sp. indet. (ex. aff. *mosquensis* Buch)
- *Pecten* (*Camptonectes*) cf. *praecinctus* Spath
- *Ostrea* sp. indet.
- *Oxytoma* (*Pteria*) sp. indet.

G.S.C. Cat. No. 23003

Locality: "Mould Bay, N.W.T. Picked up in a small stream bed. Elevation approximately 300 feet."

- ? *Acroteuthis* sp. indet.

G.S.C. Cat. No. 23005

Locality: "Mould Bay, from outcrop in the cliffs along the bay, near top of slope, 2¼ miles north of station."

- ? *Aucella* sp. indet.
- *Pecten* (*Camptonectes*) cf. *praecinctus* Spath
- *Thracia* sp. indet. (cf. *T. incerta* (Deshayes))
- ? *Modiolus* sp. indet.
- ? *Pleuromya* sp. indet. (cf. P. *tellina* Agassiz)
- ? *Lucina* sp. indet.
- ? *Arctica* sp. indet.
- *Donax* sp. indet.
- pelecypods, genus and species indet.
- gastropods, genus and species indet.

G.S.C. Cat. No. 23006

Locality: "Mould Bay, escarpment 4 miles E. of station (Gray Mountains). Collected from slabs of sandstone lying loose below outcrops, and on the surface of fine sandy soil of escarpment both above and below outcrop."

Belemnites (? *Cylindroteuthis*) sp..indet.
Aucella fischeri (d'Orb.)
Aucella trigonoides Lahusen var.
Aucella andersoni Pavlow
Aucella cf. *terebratuloides* Lahusen
Aucella sp. indet. (aff. *mosquensis* Buch)
Pecten (? *Aquipecten*) sp. indet.
Pecten (*Camptonectes*) cf. *praecinctus* Spath
Ostrea sp. indet.
Pteria (*Oxytoma*) sp. indet.
? *Anomia* sp. indet.
? *Lima* sp. indet.
Pleuromya sp. indet. (cf. P. *tellina* Agassiz)
Thracia sp. indet. (cf. *incerta* Deshayes)
? *Lucina* sp. indet.
Pelecypods, genus and species indet.
Pentacrinus sp. indet.
Ophiurites sp. indet.
A large cidaroid echinoid probably belonging to the genus.
Diplocidaris Desor
? *Terebratula* (*Rugithyris*) Cf. *rosenkrantzi* Spath

G.S.C. Cat. No. 23007

Locality: "Mould Bay, Escarpment 4 miles east of station (Gray Mountains). Specimens from outcrop and from a broken boulder at the base."

Aucella sp. indet. (possibly A. ex gr. *rugosa* Fischer)
Aucella sp. indet. (cf. *A. stantoni* Pavlow or *A. knoxvillensis* Anderson)
Aucella sp. indet.
Pecten (*Camptonectes*) sp. indet. (cf. *praecinctus* Spath)
Pecten (s. lato) sp. indet.
Pholadomya ex gr. *inaquiplicata* Stanton
? *Pholadomya* sp. indet.
? *Lucina* sp. indet.
? *Modiolus* sp. indet.
? *Corbula* sp. indet.
? *Donax* sp. indet.
? *Thracia* sp. indet.
Dentalium sp. indet.
Vertebrate bones (? ribs of a reptile)

G.S.C. Cat. No. 23008

Locality: "Mould Bay. Picked up in bed of a stream."

Indeterminate ammonoids (? Perispinctacea, genus and species indet.)
Indeterminate belemnoids
? *Pecten* (s. lato) sp. indet.

G.S.C. Cat. No. 23009

Locality: "Mould Bay, sandstone outcrop 3 miles N. of Station, elevation 100 feet, containing fossils, broken. It is lying 140 feet below the main outcrop."

Aucella piochii Gabb emend. Anderson 1945
? *Lucina* sp. indet.
? *Corbicella* sp. indet.

G.S.C. Cat. No. 23010

Locality: "Mould Bay. Found lying on beach at water's edge. About 7·5 miles north of station. Longitude 76° 23′ N., Lat. 119° 35′ W."

Inoceramus ex. gr. *retrorsus*
Keys. (could also be I. ex gr. *ovatus* Stanton)

G.S.C. Cat. No. 23011

Locality: "Mould Bay. From an outcrop at the top of cliff, elevation 240 feet, firmly imbedded in strata."

Pecten (s. lato) sp. indet.
? *Arctica* sp. indet.

G.S.C. Cat. No. 23012

Locality: "Mould Bay. From badly shattered boulder at the foot of the outcrop, 2¼ miles North of Station."

Phylloceras sp. indet. (cf. Ph. onoense Stanton)
Aucella sp. indet. (ex. gr. *stantoni* Pavlow)
Pecten (*Camptonectes*) sp. indet. (cf. P. *praecinctus* Spath)
Nucula cf. *athabascensis* McLearn
? *Lucina* sp. indet.
? *Arctica* sp. indet.
? *Tellina* sp. indet.
? *Donax* sp. indet.
Dentalium sp. indet.

G.S.C. Cat. No. 23013

Locality: "Mould Bay, outcrop above bay 3 miles north of station, approximate elevation 240 feet."

Aucella piochii Gabb emend. Anderson 1945
Aucella sp. indet.
Modiolus sp. indet. (cf. *M. boloniensis* de Loriol)
? *Lucina* sp. indet.
? *Corbicella* sp. indet.

REMARKS ON FAUNA

All the faunal lots, with the possible exception of the faunal lot No. 23010, appear to represent the same faunal and lithological facies very rich in various pelecypods of the shallow water type. This faunal and lithological facies seems to be very widespread in the Canadian Arctic during the lowermost Cretaceous and (?) uppermost Jurassic times.

STRATIGRAPHY

Lots 23009 and 23013 include, among other fossils, solitary specimens of *Aucella piochii* Gabb em. Anderson 1945. This *Aucella* form suggests an uppermost Upper Jurassic (i.e. Tithonian or Aquilonian) rather than a basal Lower Cretaceous (i.e. Riasanian or lower Infravalanginian) age for these two lots. In the Pacific faunal realm of North America, however, this species is reported to occur throughout the Newville group of Knoxville series as redefined by Anderson (1945). This group of rocks, though undoubtedly uppermost Jurassic for the most part, seems to include some

Infravalanginian rocks near its top. Therefore for the purpose of this report the above faunal lots are dated as uppermost Jurassic or (?) lowermost Cretaceous.

Lots 23002 and 23006 include, among other fossils, *Aucella fischeri* (d'Orb.), *A. trigonoides* Lahusen var., *A. andersoni* Pavlow, and A. cf. *terebratuloides* Lahusen. These forms represent an *Aucella* assemblage characteristic of the passage beds between Jurassic and Cretaceous systems, and older than the oldest undoubtedly Lower Cretaceous *A. volgensis* fauna. The total lack of *A. volgensis* Lahusen in the faunal lots here discussed precludes their reference to the *Graspedites spasskensis* zone of the upper part of the Riasanian horizon (i.e. of the lower Infravalanginian age). Nevertheless the lack of *A. piochii* Gabb em. Anderson 1945 in the same lots would suggest their lowermost Lower Cretaceous (i.e. lower Riasanian or the *Beriasella rjasanensis* zone) rather than an uppermost Jurassic age.

As the stratigraphical ranges of the *Aucella* forms occurring in lots 23002 and 23006 are not yet worked out in sufficient details, the possibility of an uppermost Jurassic age cannot be excluded; neither can their contemporaneity with the lots 23009 and 23013 be ruled out, although they are more likely to be somewhat younger.

Lots 23007 and 23012 can only be dated as of uppermost Jurassic or (?) lowermost Cretaceous age. They may be contemporary with either of the previously mentioned groups of faunal lots.

Lots 23005, 23008, and 23011 do not contain sufficiently well preserved diagnostic fossils of any kind. The close lithological similarity of the rock, in which their non-diagnostic fossils are included, with the rock of lots 23002, 23006, 23007, and 23009 is, however, suggestive of the general contemporaneity of both groups of faunal lots.

The fact that virtually all long-ranging pelecypod genera occurring in lots 23005, 23008, and 23011 are represented by apparently the same forms in lots 23002, 23006, 23007, and 23009 gives weighty support to the above suggestion, as does the close geographical proximity of both groups of faunal lots. Consequently an uppermost Jurassic of lowermost Cretaceous age is suggested tentatively for the lots 23005, 23008, and 23011.

The lot 23010 can only be dated as of Jurassic to early Lower Cretaceous age. It may or may not be much older than the other lots, since *Inoceramus* ex gr. *retorsus* Keyserling occurs in the rocks of Middle and Upper Jurassic age.

The lot 23003 could easily be younger than any of the other lots, since its belemnoids tentatively referred to the genus *Acroteuthis* appear to be of a type mainly characteristic of the rocks of earlier Valanginian and Hauterrivian ages. Their poor and fragmentary preservation precludes exact dating.

It may be mentioned that, among the late Mesozoic pelecypod faunas of the Arctic, the Portlandian fauna of Cape Leslie, Milne Land, East Greenland and that accompanying the Infravalanginian *Hectoroceras* of the S. W. Jameson Land are very closely allied to the predominantly pelecypod fauna of Prince Patrick Island listed in this report.

LICHENS OF CAPE BRETON ISLAND, NOVA SCOTIA

By I. Mackenzie Lamb

INTRODUCTION

The valuable and interesting results obtained by G. Degelius in his taxonomic investigation of the lichen vegetation in two areas of the Eastern United States (1940, 1941) encouraged the present author to attempt a similar study of a third area farther to the north, in Canada. Cape Breton Island, which forms the northern extension of the Province of Nova Scotia, was chosen for this purpose; it occupies an intermediate position between Maine in the United States, investigated by Degelius, and Newfoundland and Miquelon Island, the lichen flora of which is relatively well known from the publications of Arnold (1887, 1888, 1896, 1899), Eckfeldt (1895), Hue (1888), Hulting (1896), and Le Gallo (1952).

By such methods it is hoped in time to obtain more accurate information concerning the distribution of lichen species in the North American continent and of their relationships to those of Europe on the one side and those of Eastern Asia on the other.

The basis of the present study was an excellent collection of lichens made in Cape Breton Island by John Macoun in 1883 and 1898, in which years he spent the greater part of the summer there. They were determined for him by contemporary lichen specialists and are listed in his *Catalogue of Canadian Plants* (1902). With the exception of a few which are missing, they are all preserved in the herbarium of the National Museum of Canada at Ottawa. On revising these specimens from a modern taxonomic point of view, it was found necessary to alter many of the names, some of which were epithets then used in a much wider sense than is current at the present day, when more attention is paid to the "small species" previously lumped together in large complexes; while other names applied on the labels proved to be direct misidentifications.

Macoun's collection from Cape Breton Island comprised slightly over 122 species. In order to complement it, and to obtain representative material of the saxicolous species which Macoun largely ignored, the writer visited Cape Breton in the summer of 1952 and spent three months collecting in various parts of the island. A few specimens collected there by J. Erskine of Wolfville, N.S., and some records of *Cladonia*, kindly communicated by Dr. A. W. Evans, could also be included. By this means the number of species known from the area could be increased to 199; these are enumerated in the following pages.

The lichen flora of Cape Breton Island seems to be somewhat poorer in number of species than that of the parts of Maine investigated by Degelius, who found there 229. There seems also to be a somewhat closer correspondence to the lichen flora of northern Europe, with fewer endemic or hitherto undescribed species and varieties. Nevertheless, the genus *Pertusaria* is represented in Cape Breton by two endemic Canadian species (*P. rubefacta* Erichs. and *P. neoscotica* M. Lamb) in addition to some also occurring in Europe (*P. alpina, P. amara, P. velata*). Of considerable interest also was the finding for the first time on the North American continent of the recently described genus *Melanaria* (closely related to *Pertusaria*), represented by a new corticolous species, *M. macounii* M. Lamb. A few new varieties or forms here described in *Stereocaulon*, *Xanthoria*, etc., are of less taxonomic and distributional interest. Of the total number of species, seventeen had not been previously recorded from Canada.

NATURAL CONDITIONS OF THE AREA

A detailed account of the topography, physiography, climate, and plant ecology of Cape Breton Island has already been given in the paper of G. E. Nichols (1918), for which reason only a brief recapitulation of the most important features is necessary here.

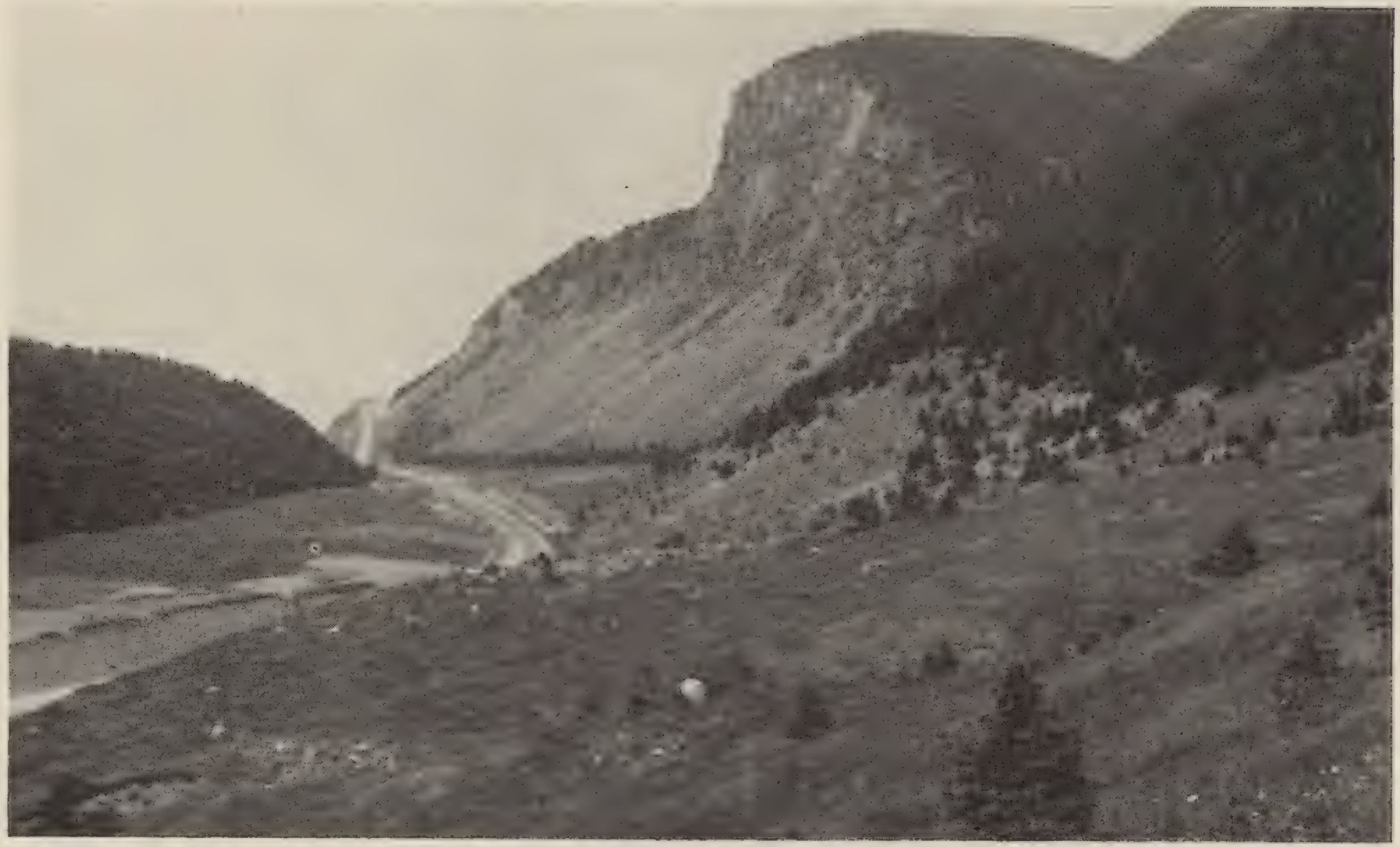
Cape Breton Island is located northeast of the main peninsula of Nova Scotia, from which it is separated by the narrow Strait of Canso, and lies in latitude 45° 30′ to 47° N., longitude 60° 15′ to 61° 30′ E. The island is somewhat over 100 miles long and a little less in width. A large part of its centre is occupied by a broad arm of the sea called the Bras d'Or, actually a drowned valley, which is connected with the outer ocean by narrow outlets. The highest parts are in the north of the island, within the limits of the Cape Breton Highlands National Park, where the land rises to a plateau, in places 1,800 feet above sea level, the highest altitude found in the Province of Nova Scotia. Lesser heights of land occur farther to the south in the Craignish Hills, the East Bay Hills, and the Boisdale and Coxheath Hills.

The island consists geologically of hard Precambrian crystalline rocks, mainly granites, covered in many places by Palæozoic strata, mostly Carboniferous, the latter including coal measures, which are worked in the Inverness and Sydney areas; sandstones, limestone and gypsum, shale, etc., the whole overlaid in extensive areas by a cap of glacial drift. Metamorphic rocks also occur in some abundance on the west side of the island and along the shores of the Bras d'Or.

The climate, as in the Maritime Provinces generally, shows both continental and oceanic influences, with considerable seasonal variation in temperature, but with lower summer temperatures and higher rainfall than in the more continental areas of Canada. This is to a certain extent due to the conjunction of the Gulf Stream from the south and the cold Polar current which sweeps southwards along the Newfoundland coasts. The mean January temperature is about 20° F., that of July about 64° F., and the annual rainfall (occurring mainly in winter) approximates to 40 inches. This type of climate is intermediate between the Continental Forest Climate and the Microthermal Snow-forest Climate, according to the nomenclature of Köppen-Geiger (1936).

Phytogeographically, the area belongs to the Acadian Forest Region, being situated near the northern edge of the Transition Forest Region, *i.e.* the region in North America between the Deciduous Forest Formation and the Northeastern Evergreen Coniferous Forest Formation. Both the latter formations are represented in Cape Breton at different elevations, the approximate altitudinal limit between them being at 750 feet above

PLATE 1



View near the coast on W. side of Cape Breton Island, Inverness Co., Cape Breton Highlands Park, between Cheticamp and Cap Rouge. Talus slope at foot of cliffs is colonized by many lichens, e.g. *Lecidea cyanea*, *Umbilicaria papulosa*, *Stereocaulon paschale*, *Lecanora intricata*, *Parmelia saxatilis*, etc. Phot. I.M.L., 4. vii. 1952.

sea-level. The highest parts of the island, on the northern plateau, are largely covered by barrens, which are transitional between the evergreen coniferous forest formation and tundra. The lowland forest consists mainly of balsam fir (*Abies balsamea*), red spruce (*Picea rubens*), yellow and white birch (*Betula lutea* and *B. papyrifera*), aspen (*Populus tremuloides, P. grandidentata* and *P. balsamifera*), maple (*Acer saccharum, A. spicatum, A. pensylvanicum,* and *A. rubrum*), elm (*Ulmus americana*) and red oak (*Quercus borealis*), whereas the more scanty forest cover of the higher plateau is composed largely of balsam fir with admixture of white and black spruce (*Picea glauca* and *P. mariana*), white birch and mountain ash (*Sorbus decora* and *S. americana*), interspersed with large barrens of heath and bog vegetation.

ACKNOWLEDGMENTS

The work of determination and revision was greatly facilitated by access to a number of the type-specimens of Nylander, Tuckerman, and Vainio, kindly lent by the University Botanical Museum, Helsinki; the Farlow Herbarium, Cambridge, Mass., and the University of Turku (Åbo), respectively. Thanks are also due to Dr. Alexander W. Evans (Yale University) who determined the *Cladoniæ* dealt with in this paper, to Dr. A. H. Magnusson (Göteborg) for assistance and advice in connection with some species of *Caloplaca* and *Lecidea*, to Dr. G. Degelius (Uppsala) for determination or confirmation of some *Collema* and *Parmelia* species, to Dr. J. Motyka (Lublin) for determining the *Usneæ* collected by the writer, and to Dr. H. Imshaug (New York) for the use of a very serviceable manuscript key to the *Buelliæ* of Nova Scotia. Grateful acknowledgment is also made to the Director of the Nova Scotia Museum of Science, Halifax, N.S., for the loan of some specimens collected in Cape Breton by J. Erskine and preserved in the herbarium of that institution. Finally, the author would like to express his appreciation of the assistance given during his visit to Cape Breton in 1952 by the Superintendent and other personnel of the Cape Breton Highlands National Park at Ingonish and Cheticamp.

TAXONOMIC PART

In the following enumeration of the lichens known from Cape Breton Island, the following entities are new to science:*

Caloplaca (*Eucaloplaca*) *fraxinea* M. Lamb (p. 304)

Lecanora (*Placodium*) *microbola* M. Lamb (p. 291)

Melanaria macounii M. Lamb, with var. *meizotoca* M. Lamb (pp. 286-288)

Pertusaria neoscotica M. Lamb (p. 284)

Stereocaulon paschale f. *colligatum* M. Lamb (p. 273) and f. *laxatum* M. Lamb (of subsp. *evolutoides*) (p. 275)

Xanthoria polycarpa var. *maritima* M. Lamb (p. 308)

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* Type-specimens deposited in Herb. Nat. Mus. Canada, Ottawa, unless otherwise stated.

The following new combinations are made:

Caloplaca atrosanguinea (Merr.) M. Lamb (Syn. *Lecanora atrosanguinea* Merrill) (p. 305)

Caloplaca vitellinula f. *lignicola* (Nyl.) M. Lamb (Syn. *Lecanora aurantiaca* f. *lignicola* Nyl., *Caloplaca aurantiaca* f. *lignicola* Th. Fr.) (p. 306)

Cetraria crispa f. *minor* (Grogn.) M. Lamb (Syn. *C. islandica* var. *crispa* f. *minor* Grogn.) (p. 299)

Lecidea recensa f. *arcuatula* (Arn.) M. Lamb (Syn. *Biatora arcuatula* Arn.) (p. 254)

Melanaria amaurospora (Hellb.) M. Lamb (Syn. *Pertusaria amaurospora* Hellb.) (p. 288)

Melanaria callispora (Zahlbr.) M. Lamb (Syn. *Pertusaria callispora* Zahlbr.) (p. 288)

Melanaria subochracea (Stirt.) M. Lamb (Syn. *Pertusaria subochracea* Stirt.) (p. 288)

Melanaria phæosporina (Zahlbr.) M. Lamb (Syn. *Pertusaria phæosporina* Zahlbr.) (p. 288)

Melanaria tesselaria (Müll. Arg.) M. Lamb (Syn. *Pertusaria tesselaria* (Müll. Arg.) (p. 288.)

Pseudocyphellaria mougeotiana f. *aurigera* (Del.) M. Lamb (Syn. *Sticta aurigera* Del., *Pseudocyphellaria mougeotiana* var. *aurigera* H. Magn.) (p. 250)

Stereocaulon coralloides var. *spissum* (Nyl. emend.) M. Lamb (Syn. *St. spissum* Nyl. emend.) (p. 272)

Stereocaulon paschale subsp. *depreaultii* (Del. ex Nyl.) M. Lamb (Syn. *St. depreaultii* Del. ex Nyl.), with var. *cæspitosulum* (Nyl.) M. Lamb (Syn. *St. denudatum* var. *cæspitosulum* Nyl.), and subsp. *evolutoides* (H. Magn.) M. Lamb (Syn. *St. paschale* var. *evolutoides* H. Magn., *St. evolutoides* Frey) (pp. 273-274).

Seventeen species had not been previously recorded from Canada, namely:

Acarospora amphibola Wedd.
Buellia stillingiana Stnr.
Caloplaca vitellinula Nyl. (represented by the f. *lignicola*)
Collema subfurvum (Müll. Arg.) Degel.
Lecanora lævis Poelt
Lecidea albidocinerella (Vain.) Vain.
Lecidea furvella Nyl.
Lempholemma fasciculare (Wulf.) Zahlbr.
Lichina confinis (Müll.) Ag.
Parmelia subquercifolia Hue
Physcia ascendens Bitt.
Pseudocyphellaria mougeotiana (Del.) Vain.
Rhizocarpon tetramerum (Vain.) Vain.
Usnea fibrillosa Mot.
Usnea scabrata Nyl.
Verrucaria erichsenii Zschacke
Verrucaria umbrinula Nyl.

Some taxonomic notes are also given on the *Lecidea latypiza*- and *Parmelia subquercifolia*-groups (pp. 255, 297, respectively).

VERRUCARIACEAE

Verrucaria acrotella Ach.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 20 m.s.m., on a schistose stone submerged in a brook, coll. I.M.L., July 1, 1952 (No. 6808). Fert.

No thallus developed. Perithecia thickly scattered on the bare stone, about 0·2 mm. diam., black, hemispherical, with minute, hardly visible ostiole, many of the perithecia eroded to leave only the black, ring-like base. Involucrellum well developed at sides, 45 to 70μ thick, reaching to the base, also continued as a thinner (17 to 20μ) dark brown cellulose layer below the excipulum. Excipulum globose, about 120μ diam., colourless, 10 to 14μ thick. Spores ellipsoid or subelongate-ellipsoid, 15 to 17 x 6 to 7μ. Hymenial mucilage I + wine-red.

Corresponds to the typical form of the species ("crusta nulla": Ach., Meth. Lich. 1803, p. 123, *descr. orig.*), which Vainio unnecessarily named *V. acrotella* f. *subathallina* Vain. (Lichenogr. Fennic. I, 1921, p. 41). The writer's specimen agrees very well with an authentic specimen of *V. acrotella* f. *subathallina* from Finland, Suursaari (Hogland), Mäkienpäällys, coll. Vainio, 1875 (No. 30351 in herb. Vain.).

Verrucaria erichsenii Zschacke

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, on steep rocks at the seashore, in the lower hygrohaline zone, above high tide level, but within the spray zone, coll. I.M.L., July 1, 1952 (No. 6810). Fert.

Cape Breton Co.: Mainadieu, on the shoreward side of marine rocks at the extreme point, in the lower hygrohaline, about 3 m. above the sea, coll. I.M.L., July 23, 1952 (No. 6920). Fert.

New to Canada. The Mainadieu specimen has a patchy and somewhat scattered thallus, approaching the f. *maculiformis* Erichs.

There is a remarkable scarcity of marine *Verrucaria*-species on the coasts of Cape Breton: this was the only species seen. Nevertheless, on the coast of Maine, Degelius discovered four of them (*V. erichsenii*, *V. microspora*, *V. mucosa*, and *V. striatula*); see Degelius, 1940, p. 11.

Verrucaria umbrinula Nyl.

Victoria Co.: Ingonish, Middle Head, alt. *circ.* 25 m.s.m., on a granitic boulder beside trail through spruce woods, forming a sooty covering over a large area of the rock, coll. I.M.L., July 29, 1952 (No. 6951). Fert.

New to Canada. Reported by Degelius (1940, p. 12) from Maine in the f. *macrospora* Vain. The writer's specimen belongs to the typical form of the species, with spores 13 to 17 x 5·0 to 6·8μ.

DERMATOCARPACEAE

Dermatocarpon fluviatile (Web.) Th. Fr. (Syn. *D. aquaticum* (Weis) Zahlbr.)

Inverness Co.: Margaree, on rocks in a stream, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 174, *s. n. Endocarpon fluviatile*).

No perithecia found, but pycnidia numerous, with crowds of straight bacillar conidia 3 to 4 by 0·7μ.

PYRENULACEAE

Porina (?) sp.

Macoun, 1902, p. 175, records *Sagedia cestrensis* Tuck. (= *Porina cestrensis* (Tuck.) Müll. Arg.) from Inverness Co., Margaree, on bark of maples. The specimen, preserved in the National Museum herbarium, seems to be a *Porina* but is unfortunately destitute of spores and therefore cannot be determined with certainty. The thallus is scanty and ill-developed, white or whitish, very thin, subfurfuraceous, and the plant is obviously not *P. cestrensis*, which has a well-developed, dark grey or blackish green, rimose thallus (type-specimen seen in herb. Tuckerman, Farlow Herb.).

Pyrenula nitida (Weig.) Ach.

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on trunk of *Fagus* in mixed woods, coll. I.M.L., June 15, 1952 (No. 6667). Fert.

Victoria Co.: Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on trunk of *Fagus* at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6869). Fert.

TRYPETHELIACEAE

[*Trypethelium virens* Tuck.

This species has been recorded from Inverness Co., Big Intervale, by Macoun, 1902, p. 174, but there is no corresponding specimen now present in the National Herbarium nor at the Farlow Herbarium.]

SPHÆROPHORACEAE

Sphærophorus fragilis (L.) Pers.

Victoria Co.: Mary Ann River Fire Trail, alt. 1,400 feet, on rock, associated with the moss *Rhacomitrium lanuginosum*, coll. J. S. Erskine, Aug. 9, 1951 (No. 50 C 1545). Ster.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., between stones on the site of the fortifications, exposed position, coll. I.M.L., July 19, 1952 (No. 6889). Ster.

Sphærophorus globosus (Huds.) Vain.

Victoria Co.: About 8 miles up the Clyburn Valley from Ingonish, alt. *circ.* 420 m.s.m., on a sloping, partly mossy rock face near a waterfall, coll. I.M.L., Aug. 9, 1952 (No. 7003). Ster.—8 miles N.W. of Baddeck, alt. *circ.* 100 m.s.m., on trunk of *Tsuga canadensis* by the roadside, coll. I.M.L., July 14, 1952 (No. 6851). Ster.

Cape Breton Co.: Mainadieu, in crevices of rocks at top of cliffs about 10 m. above the sea, coll. I.M.L., July 23, 1952 (No. 6926). Ster.

According to Nichols, 1918, p. 400, *Sph. coralloides* (= *Sph. globosus*) is one of the characteristic species of the upper barrens.

GRAPHIDACEAE

Xylographa abietina (Pers.) Zahlbr. (Syn. *X. parallela* (Ach.) Behl. & Desb.)

Inverness Co.: Margaree, on old fence rails, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 167, *s.n. X. parallela*). Fert.

No perceptible thallus developed, nor is the lignum around the apothecia stained by KHO.

Xylographa opegraphella Nyl.

Inverness Co.: Margaree, on old fence rails, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 168). Fert.

The original publication of this species was by Nylander in Mém. Soc. Sci. Nat. Cherbourg, IV (1856), p. 88, footnote, but no description was given. In volume V of the same series (1857), p. 128, it was again mentioned as a nomen nudum, but this time with reference to the exsiccat Tuckerm. Lich. Amer. Septentr. No. 97 ("*Opegrapha stictica* Fr. & Tuckerm."). The first valid publication with description was by Rothrock in Proc. U. S. Nat. Mus. VII (1884), p. 8, where it is recorded from Alaska, Cook's Inlet, coll. T. H. Bean, 1880. Strictly speaking, therefore, the Alaskan specimen should be regarded as the type. But it could not be found in the Farlow Herbarium, and provisionally the above-mentioned Tuckerman exsiccat may be regarded as authentic material of the species; Macoun's specimen agrees very well with it. In Tuckerm. Lich. Amer. Septentr. No. 97, the thallus is KHO + (slowly) red, $CaCl_2O_2$ − , PD + persistent yellow; in Macoun's specimen the thallus is externally KHO − , PD − , but the medulla is KHO + orange to orange-red, PD + yellow.

Graphis scripta (L.) Ach.

Victoria Co.: Baddeck, on *Alnus*, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 168, *s.n. Gr. scripta* var. *limitata*). Fert.

F. **recta** (Humb.) Körb.

Victoria Co.: Baddeck, on *Betula*, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 168, *s.n. Gr. scripta* var. *recta*). Fert.—Also recorded by Macoun, loc. cit. from Inverness Co., Margaree, but there is no specimen from that locality now present in the National Herbarium.

Var. **serpentina** (Ach.) Meyer

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on trunk of *Fagus* in mixed woods, coll. I.M.L., June 15, 1952 (No. 6666). Fert.—Vicinity of Whycocomagh, alt. *circ.* 165 m.s.m., on trunk of *Acer* beside trail through open mixed woods, coll. I.M.L., Aug. 21, 1952 (No. 7025). Fert.

CHRYSOTHRICACEAE

Crocynia membranacea (Dicks.) Zahlbr. (Syn. *C. lanuginosa* (Ach.) Hue)

Inverness Co.: Margaree, on limestone rocks in ravines, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 92, *s.n. Pannaria lanuginosa*). Ster.—Big S. W. Aspy, on grit in rock cleft, coll. J. S. Erskine, 1952 (No. 1962). Ster.

Seen also in the Cape Breton Highlands Park between Cheticamp and Cap Rouge, on rocks of a stream-gully, but not collected.

DIPLOSCHISTACEAE

Conotrema urceolatum (Ach.) Tuck.

Inverness Co.: Margaree, on trunks, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 121). Fert.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on trunks of *Acer* and *Fagus* by the roadside, coll. I.M.L., June 22, 1952 (Nos. 6732, 6735). Fert.

Victoria Co.: Baddeck, on trunks of trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 121). Fert.—Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on trunk of *Acer* at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6860). Fert.

LICHINACEAE

Lichina confinis (Müll.) Ag.

Cape Breton Co.: Mainadieu, on the shoreward side of marine rocks at the extreme point, in the lower hygrohaline zone, about 3 m. above the sea, coll. I.M.L., July 23, 1952 (No. 6922). Ster.

New to Canada, but known from U.S.A. (Massachusetts).

COLLEMACEAE

Lempholemma fasciculare (Wulf.) Zahlbr.

Inverness Co.: Margaree, over moss on rocks, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 95, *s.n. Collema myriococcum*). Fert.

New to Canada. The specimen agrees well with Arnold Lich. Exs. No. 1782 ("*Physma Mülleri*") in Farlow Herb., this exsiccat representing *L. fasciculare* according to Lettau, 1942, p. 300. Spores 8nae, biseriate in ascus, simple, ellipsoid to broadly ellipsoid, 13·5 to 15·0 x 7 to 9 μ, smooth-walled.

In the closely related *L. chalazanum* (Ach.) B. de Lesd. the spores are longer, 18 to 29 x 8 to 13 μ, and their wall is minutely punctate-scabrid, at least in Claud. & Harm. Lich. Gall. Exs. No. 205 ("*Collema chalazanum*"). The true *L. myriococcum* (Ach.) Th. Fr. is supposed to differ in its globose spores, 9 to 12 μ diam., according to Nylander, Synops. Lich. I (1858), p. 104, Pl. IV, fig. 21, and Lich. Scand. (1861), p. 29.

Collema (Synechoblastus) **leptaleum** Tuck.

Victoria Co.: Baddeck, on *Fraxinus* in a swamp, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 95). Fert.

Tuckerman's authentic material was not at the time available for comparison, but the specimen agrees well with his description in Synops. N. Amer. Lich. I (1882), p. 146; habitually resembling *C. aggregatum* (Ach.) Röhl. (e.g. Mougeot & Nestler, Stirp. Cryptog. Vogeso-Rhenan. No. 453, *s.n. Collema thysanœum*), but with shorter spores, 34 to 45 x 3·0 to 3·5 (−4·0)μ, transversely 3- to 4-septate, usually curved, their ends rounded or obtusely tapered, not pointed.

[*Collema* (*Collemodiopsis*) *nigrescens* (Huds.) DC.

Recorded from Victoria Co., Baddeck, by Macoun, 1902, p. 96, but no corresponding specimen could be found in the National Herbarium.]

Collema (Collemodiopsis) **subfurvum** (Müll. Arg.) Degel. in Bot. Notiser, 1948, pp. 139-140 (Syn. *Synechoblastus flaccidus* var. *subfurvus* Müll. Arg.).

Victoria Co.: Baddeck, on *Fraxinus*, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 100, *s.n. Leptogium chloromelum*). Ster.

New to Canada. Similar and closely related to *C. flaccidum* Ach. (Syn. *C. rupestre* (Sw.) Rabh.), differing in the form of the isidia, which are granulose or granulose-digitate, not becoming squamulose as in *C. flaccidum* (see remarks of Degelius, loc. cit.). Confirmed by Dr. Degelius, who writes in litt. 10. iv. 1953: "This species is not rare in the eastern parts of North America."

Leptogium cyanescens (Ach.) Körb. (Syn. *L. cæsium* (Ach.) Vain.)

Inverness Co.: Half Way Brook, on old logs, coll. J. Macoun, Aug. 6, 1898, ster., Margaree, on logs and tree trunks, coll. J. Macoun, July 22, 1898, ster. (both recorded by Macoun, 1902, p. 99, *s.n.* *L. Tremelloides*).—Craigmore, alt. *circ.* 135 m.s.m., on mossy rocks near a stream beside trail through mixed woods, coll. I.M.L., June 15 and 19, 1952 (Nos. 6656, 6710, the former fert.).—Cape Breton Highlands Park, near the Cheticamp entrance, alt. *circ.* 35 m.s.m., on sandstone rock at side of trail through mixed woods, coll. I.M.L., July 5, 1952 (No. 6833). Fert.

Victoria Co.: Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., among mosses at base of trunk of *Populus* at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6861). Fert.—Also recorded (as *L. Tremelloides*) by Macoun, loc. cit., from Baddeck and Smoky Mountain, but no specimens from these localities present in the National Herbarium.

PANNARIACEAE

Pannaria pezizoides (Web.) Trev.

Inverness Co.: Cape Breton Highlands Park, near the Cheticamp entrance, alt. *circ.* 35 m.s.m., on soil bank at side of trail through mixed woods, coll. I.M.L., July 5, 1952 (No. 6841). Fert. Between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., over mosses on soil bank in wooded stream-gully, coll., I.M.L., July 3, 1952 (No. 6816). Fert.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 135 m.s.m., over mosses on soil at side of trail through mixed woods, coll. I.M.L., Aug. 6, 1952 (No. 6999). Fert.

Massalongia carnosa (Dicks.) Körb.

Inverness Co.: Half Way Brook, on mosses over rocks, coll. J. Macoun, Aug. 6, 1898 (Macoun, 1902, p. 94, *s.n.* *Pannaria lepidiota*). Fert.

Parmeliella corallinoides (Hoffm.) Zahlbr.

Inverness Co.: Craigmore, alt. *circ.* 200 m.s.m., on trunk of *Acer* beside trail through mixed woods, coll. I.M.L., June 16, 1952 (No. 6696). Fert.—Margaree, on tree trunks, coll. J. Macoun, July 17, 1898 (Macoun, 1902, p. 94 *s.n.* *Pannaria lepidiota*). Ster.

Parmeliella lepidiota (Smrft.) Vain.

Inverness Co.: vicinity of Margaree, on earth, coll. J. Macoun, July 14, 1898, distributed in Macoun's Canad. Lich. No. 100 ("*Pannaria lepidiota*"). Ster. No exact locality is given on the label, but the date indicates that it must have been collected in the vicinity of Margaree.

This terricolous specimen does not seem to correspond to either of the two records of "*Pannaria lepidiota*" given in Macoun Cat. p. 94, one of which refers to *Massalongia carnosa* and the other to *Parmeliella corallinoides.*

Parmeliella plumbea (Lightf.) Müll. Arg.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 20 m.s.m., on a metamorphic rock in partial shade of tree, associated with *Nephroma lusitanicum*, coll. I.M.L., July 1, 1952 (No. 6791). Fert.

STICTACEAE

Lobaria (Ricasolia) **pulmonaria** (L.) Hoffm.

Inverness Co.: Craigmore, alt. 100 to 135 m.s.m., on trunks of *Picea*, *Fagus*, and other trees in mixed woods, abundant and fertile, coll. I.M.L., June 13 and 14, 1952 (Nos. 6645, 6653). Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on trunk of *Acer* by roadside, coll. I.M.L. June 22, 1952 (No. 6716). Fert.

Victoria Co.: Baddeck, coll. J. Macoun, July 9 and 16, 1898 (Macoun, 1902, p. 83, *s.n. Sticta pulmonaria*). Fert.—8 miles N.W. of Baddeck, alt. *circ.* 100 m.s.m., on trunk of *Acer* at edge of woods by the roadside, coll. I.M.L., July 14, 1952 (No. 6855). Fert.—W. side of Great Bras d'Or between Ross Ferry and New Campbellton, alt. *circ.* 235 m.s.m., on trunk of *Fagus* in open mixed woods, coll. I.M.L., July 24, 1952 (No. 6933). Fert.

All the specimens belong to the typical form of the species, as defined by Degelius, 1941a, p. 17.

Lobaria quercizans Michx.

Inverness Co.: Craigmore, alt. 100 to 135 m.s.m., on trunks of *Fagus* in mixed woods, common, often associated with *L. pulmonaria*, coll. I.M.L., June 13 and 14, 1952 (Nos. 6635, 6654). Fert.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on trunk of *Acer* by the roadside, coll. I.M.L., June 22, 1952 (No. 6717). Fert.

Victoria Co.: W. side of Great Bras d'Or between Ross Ferry and New Campbellton, alt. *circ.* 235 m.s.m., on trunk of *Acer* in open mixed woods, coll. I.M.L., July 24, 1952 (No. 6932). Fert.—About 4 miles up the Clyburn Valley from Ingonish, alt. *circ.* 50 m.s.m., on trunk of *Fraxinus* by trail through deciduous woods, coll. I.M.L., Aug. 9, 1952 (No. 7007). Fert.—Baddeck, on trees, coll. J. Macoun, July 8 and 9, 1898 (Macoun, 1902, p. 82, *s.n Sticta amplissima*). Fert.—Also recorded by Macoun, loc. cit. (as *Sticta amplissima*) from Inverness Co., Big Intervale, Margaree, but no specimen from there now present in the National Herbarium.

Lobaria (Lobarina) **verrucosa** (Huds.) Hoffm. (Syn. *L. scrobiculata* (Scop.) Gärtn., Mey. & Scherb.)

Inverness Co.: Big Intervale, on trees in woods, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 85, *s.n. Sticta scorbiculata*). Ster.—Craigmore, alt. 85 to 200 m.s.m., on trunks of *Acer*, *Betula*, and *Fagus* in mixed woods, coll. I.M.L., June 12, 13, and 16, 1952 (Nos. 6614, 6638, 6679). No. 6638 sparingly fert.—Vicinity of Margaree Forks, alt. *circ.* 85 m.s.m., on trunk of *Betula* in mixed woods, coll. I.M.L., June 23, 1952 (No. 6744). Ster.

Victoria Co.: Baddeck, on *Picea*, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 85, *s.n. Sticta scorbiculata*). Ster.—8 miles N.W. of Baddeck, alt. *circ.* 100 m.s.m., on trunk of *Abies* at edge of woods near the road, coll. I.M.L., July 14, 1952 (No. 6850). Ster.

The medulla and soredia in this species stain orange with Paraphenylenediamine. This, together with the distinct yellowish colour of the thallus, serves to distinguish *L. verrucosa* from the closely related *L. Hallii* (Tuck.) Zahlbr.; see Ahlner, 1948, p. 62.

Pseudocyphellaria mougeotiana (Del.) Vain.

Inverness Co.: Vicinity of Margaree Forks, alt. *circ.* 85 m.s.m., on trunk of *Betula* in mixed woods, coll. I.M.L., June 23, 1952 (No. 6743). Ster.

Victoria Co.: Baddeck, on trunks, coll. J. Macoun, July 29, 1898 (Macoun, 1902, p. 84 *s.n. Sticta crocata*). Ster.

New to Canada. Macoun stated it to be "quite common" at Baddeck (loc. cit.), but to the writer it seemed to be very scarce; only one small plant was found at Margaree Forks. *Pseudocyphellaria* is a tropical and subtropical genus with only a few species penetrating into the oceanic parts of the boreal temperate regions. The distribution of the closely related *Ps. crocata* (L.) Vain. has been dealt with in detail by Degelius, 1935, pp. 145-150; that of the present species is less well known but is probably similar. Degelius found it in Maine (Degelius, 1940, p. 21), and Magnusson (1940, p. 18) lists some other N. American localities, all in Maine.

Macoun's specimen from Baddeck belongs to the f. *aurigera* (Del.) M. Lamb, **n. comb.** (Syn. *Sticta aurigera* Del., *St. mougeotiana* var. *aurigera* Nyl., *Pseudocyphellaria mougeotiana* var. *aurigera* H. Magn.), characterized by numerous pulvinate yellow soredia on the surface as well as on the margins, and certainly nothing more than a forma intergrading with the typical state of the species.

PELTIGERACEAE

Nephroma (Eunephroma) **arcticum** (L.) Torss.

Victoria Co.: Smoky Mountain, coll. J. Macoun, Aug. 3, 1898 (Macoun, 1902, p. 85). Fert.—Aspy Trail, over mosses on ground, coll. J. S. Erskine, July 28, 1950 (No. 50 C 1507). Ster.—Near Sunset Cape North, alt. *circ.* 85 m.s.m., over mosses on the ground in open mixed woods, coll. I.M.L., July 31, 1952 (No. 6955). Ster.

Also recorded by Macoun, loc. cit., from Inverness Co., Half Way Brook, but no corresponding specimen is present in the National Herbarium.

Nephroma (Nephromium) **lusitanicum** Schaer.

Inverness Co.: Craigmore, alt. *circ.* 200 m.s.m., on a fallen mossy trunk beside trail through mixed woods, coll. I.M.L., June 16, 1952 (No. 6672). Fert.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on trunk of *Populus* by the roadside, coll. I.M.L., June 22, 1952 (No. 6730). Fert.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 20 m.s.m., on a metamorphic rock in partial shade of trees, forming large ± orbicular patches, and associated with *Parmeliella plumbea*, coll. I.M.L., July 1, 1952 (No. 6792). Fert.

Victoria Co.: W. side of Great Bras d'Or between Ross Ferry and New Campbellton, alt. *circ.* 235 m.s.m., on trunk of *Acer* in open mixed woods, coll. I.M.L., July 24, 1952 (No. 6930). Fert.—About 4 miles up the Clyburn Valley from Ingonish, alt. *circ.* 50 m.s.m., on trunk of *Fraxinus* beside trail through deciduous woods, coll. I.M.L., Aug. 9, 1952 (No. 7002). Fert.

Nephroma parile (Ach.) Ach.

Inverness Co.: Big Intervale, on rocks and in ravines, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 86, *s.n. N. lævigatum* var. *parile*). Ster.

Victoria Co.: McNeil's Harbour, on rocks, coll. J. Macoun, Aug. 4, 1898 (Macoun, 1902, p. 86, *s.n. N. lævigatum* var. *parile*. Ster.

Nephroma subtomentellum (Nyl.) Gyeln. (Syn. "*Nephroma lævigatum*" auctt., *non* Ach.; *cf. infra*).

Inverness Co.: Big Intervale, on boulders, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 86, *s.n. N. lævigatum*). Fert.—Craigmore, alt. *circ.* 135 m.s.m., at base of trunk of *Fagus* and on mossy rock beside a stream in mixed woods, coll. I.M.L., June 15, 1952 (Nos. 6655, 6657). Fert.

Victoria Co.: Baddeck, on trees in woods, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 86, *s.n. N. lævigatum*). Fert.—McNeil's Harbour, on rocks, coll. J. Macoun, Aug. 4, 1898 (Macoun, 1902, p. 86, *s.n. N. lævigatum*). Fert.

Gyelnik, 1935, p. 12, has shown that the type material of *Nephroma lævigatum* in herb. Acharius is not the species commonly known by that name but is *N. lusitanicum* or a closely allied species, with medulla KHO + reddish-violet. We must accordingly seek another name for the plant commonly known as "*Nephroma lævigatum*". *Peltigera papyracea* Hoffm. (1796), placed as a forma under *N. lævigatum* in Zahlbr. Cat. Lich. Univ., has been shown by Vainio (1888, p. 11) to be *N. tomentosum* Nyl. (= *N. resupinatum* (L.) Ach.). *Nephroma bella* Tuckerm. (1841), based on *Peltigera bella* Sprgl. (1827), is listed in Zahlbruckner's Catalogus as a synonym of *N. lævigatum*, but its identity is quite uncertain. Several of Gyelnik's new entities published in his "Nephroma-Studien" (1932) and elsewhere, e.g. *N. lævigatoides* Gyeln. and *N. Filarszkyanum* Gyeln., appear to belong to our species, but a prior epithet which undoubtedly refers to it is *subtomentellum* (Nyl. in Not. ur Sällsk. Fauna et Flora Fennic. Förhandl. V, 1866, p. 116, as var. of *N. lævigatum*; Crombie, Monogr. Brit. Lich. I, 1894, p. 285, as *Nephromium subtomentellum*; Gyelnik in Hedwigia, LXXII, 1932, p. 29, as *Nephroma subtomentellum*). The type of this was revised by Gyelnik in his "Revisio Typorum" (loc. cit., 1935, p. 14), where a detailed description is given. The thallus was found to be "pubescent" on the underside, and the medulla white, KHO −. "Pubescent" in the sense of Gyelnik means only with microscopic downy hairs, not or hardly visible under the hand lens (Gyelnik, op. cit., 1932, p. 2). Du Rietz (1929) has shown that the present species ("*N. lævigatum*") varies considerably as regards the tomentosity of the under surface, from quite glabrous to obsoletely or sometimes rather distinctly tomentose (although never approaching the long and dense tomentum of *N. resupinatum*), this variation probably depending on environmental conditions and without taxonomic significance. The microscopic tomentum is well shown in the section figured by Galløe (1939) on Pl. 64, fig. 404 (*s.n. N. lævigatum*).

Peltigera (Phlebia) **aphtosa** (L.) Willd.

Cape Breton Co.: E. side of St. Andrew Channel between Barachois and George River, alt. *circ.* 30 m.s.m., on soil bank at edge of mixed woods by the roadside, coll. I.M.L., July 22, 1952 (No. 6912). With immature apoth.

Var. **variolosa** (Mass.) Thoms.

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., among mosses on the ground in mixed woods, rather common, coll. I.M.L., June 13, 1952 (No. 6631). With immature apoth.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on the ground among mosses in open mixed woods, coll. I.M.L., June 22, 1952 (No. 6725). Fert.

Victoria Co.: Baddeck, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 88, *s.n. P. aphthosa*). Fert.—Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on mossy bank at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6857). Ster.

The specimen from Margaree mentioned by Macoun, loc. cit., is not present in the National Herbarium.

Peltigera (Emprostea) **canina** (L.) Willd.

The typical species is recorded by Macoun, 1902, p. 90, from Baddeck in Victoria Co. and Margaree in Inverness Co. In the National Herbarium there are two specimens from Margaree, collected by Macoun on July 14 and 16, 1898, respectively. The former is *P. polydactyla* with a few intermixed fragments which may be either *P. canina* or *P. membranacea*, and the latter is *P. membranacea*. No specimen from Baddeck is present. The writer did not find the typical form of *P. canina* in Cape Breton, nor does J. W. Thomson list it from there in his monograph (1950).

Var. **albescens** (Wbg.) Thoms. (Syn. *P. canina* var. *leucorrhiza* (Flk.) Flot.)

This variety has been recorded from Victoria Co., Big Harbour, coll. Prince, 1928, by Thomson, 1950, p. 44.

Var. **rufescens** (Weis) Mudd

Inverness Co.: Craigmore, alt. *circ.* 85 m.s.m., on a mossy rock in open spruce woods, coll. I.M.L., June 12, 1952 (No. 6619). Fert.—Cape Breton Highlands National Park, near the Cheticamp entrance, alt. *circ.* 35 m.s.m., on mossy roadside bank, coll. I.M.L., July 1, 1952 (No. 6793). Fert.

Recorded by Macoun, 1902, p. 89 (as *P. rufescens*) from Margaree in Inverness Co., but this refers to a specimen of *P. polydactyla* collected by him on July 16, 1898, and first determined as *P. rufescens*, then subsequently altered by him to *P. polydactyla.* However, Thomson, 1950, p. 49, quotes a specimen from Inverness Co., Big Intervale, coll. Macoun, 1893 (1898 ?) as *P. canina* var. *rufescens* in the Farlow Herbarium.

Peltigera horizontalis (Huds.) Baumg.

Inverness Co.: Margaree, on rocks in woods, coll. J. Macoun, July 14, 1898 (Macoun, 1902, p. 88). Fert.

Peltigera membranacea (Ach.) Nyl. emend. Thoms.

Inverness Co.: Margaree, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 90, *s.n. P. canina*). Fert.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 165 m.s.m., on a moss-covered boulder at side of trail through mixed woods, coll. I.M.L., Aug 6, 1952 (No. 6995). Fert.

Thomson, 1950, p. 64, also mentions this species from Victoria Co., Baddeck ("Braddock"), coll. Macoun, 1898, and Big Harbour, coll. Prince, 1928.

The writer agrees with Thomson (op. cit.) in regarding this as a proper species. It differs from *P. canina* in the thinner and distinctly nitidous thallus. The rhizinae are brush-like (penicillate), whereas in *P. canina* they are usually (although not always) simple or with lateral downy fibrillae. Lindahl, however (1953, p. 105), considers *P. membranacea* as not specifically distinct from *P. canina.*

Peltigera polydactyla (Neck.) Hoffm.

Inverness Co.: Margaree, coll. J. Macoun, July 14, 1898, intermixed with a few small fragments which may be either *P. canina* or *P. membranacea* (Macoun, 1902, p. 90, *s.n. P. canina*). Fert. This material distributed as *P. polydactyla* in Macoun's Canad. Lich. No. 90.—Margaree, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 89, *s.n. P. rufescens*). The determination on the label subsequently corrected by Macoun to *polydactyla.*—Cape Breton Highlands National Park, near Cap Rouge, alt. *circ.* 35 m.s.m., on a moss-covered, partially shaded rock face in gully of a brook, coll. I.M.L., June 30, 1952 (No. 6770). Fert.

Victoria Co.: W. side of Great Bras d'Or between Ross Ferry and New Campbellton, alt. *circ.* 235 m.s.m., over mosses on a large boulder by the roadside, coll. I.M.L., July 24, 1952 (No. 6931). Ster.

The specimen from Victoria Co., Baddeck, recorded under *P. polydactyla* on page 88 of Macoun's Catalogue, could not be found in the National Herbarium. *P. polydactyla* (var. *typica*) has also been recorded from Victoria Co., Barrasois River, coll. Nichols, 1914, by Thomson (1950, p. 31).

The writer's No. 6931 from Victoria Co., being sterile, cannot be definitely determined as this species but may possibly be *P. horizontalis.*

F. **microcarpa** (Ach.) Merat

This form has been recorded from Victoria Co., Baddeck, coll. Prince, 1928, by Thomson, 1950, p. 35.

Peltigera scabrosa Th. Fr.

Victoria Co.: Smoky Mountain, on rocks, coll. J. Macoun, Aug. 3, 1898 (Macoun, 1902, p. 89 *s.n. P. pulverulenta*). Fert.

A small but quite typical specimen.

Peltigera spuria (Ach.) DC.

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on a mossy vertical rock face with *Cladoniæ*, in mixed woods, coll. I.M.L., June 19, 1952 (No. 6712). Fert.

Victoria Co.: Plaister Mines near Baddeck, alt. *circ.* 35 m.s.m., on a grassy soil bank by the roadside, coll. I.M.L., July 17, 1952 (No. 6872). Fert.

LECIDEACEAE

Lecidea (Biatora) **albofuscescens** Nyl.

Victoria Co.: Baddeck, on balsam and spruce bark, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 144, *s.n. Biatora sanguineo-atra*). Fert.—Franey Mountain trail near Ingonish, alt. *circ.* 165 m.s.m., on lower trunk of *Fagus* beside trail through mixed woods, associated with *L. helvola*, coll. I.M.L., Aug. 6, 1952 (No. 6998 pr. p.). Fert.

Lecidea coarctata (Turn.) Nyl.

F. **cotaria** (Ach.) Nyl.

Inverness Co.: vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on bare earth of a soil bank by roadside, coll. I.M.L., June 25, 1952 (No. 6757). Fert.

Thallus evanescent, confused with the earthy substratum. Apothecia blackish, irregular, immarginate, convex.

Var. **elachista** (Ach.) Th. Fr.

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on a wet boulder in a stream in open woods, coll. I.M.L., June 15, 1952 (No. 6663). Fert.

Thallus thin, rimose, pale green in the moist living condition, becoming roseate-whitish on drying.

Var. **ornata** (Smrft.) Malbr.

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on a large boulder at side of road in spruce-fir woods, associated with *Rhizocarpon plicatile*, coll. I.M.L., June 19, 1952 (No. 6698). Fert.

Thallus well developed, subeffigurate. Apothecia with conspicuous inner and outer margins, the inner rupturing by an apical pore and finally lacerate-reflexed.

Lecidea fuscorubens (Nyl.) Nyl.

Inverness Co.: vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on vertical face of a limestone outcrop at bank of river, partly shaded by trees, coll. I.M.L., June 22, 1952 (No. 6738). Fert.

Abundant, forming large irregular confluent patches. The very thin thallus has a faintly ochraceous tinge, and so the specimen approaches the var. *ochracea* (Hepp) Oliv.

Lecidea granulosa (Ehrh.) Ach.

Inverness Co.: Half Way Brook, on earth, coll. J. Macoun, Aug. 6, 1898 (Macoun, 1902, p. 142, *s.n. Biatora granulosa*). Fert.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on soil of roadside bank, partly associated with *Cladoniæ* and *Polytrichum*, coll. I.M.L., June 28, 1952 (Nos. 6762, 6766). Fert.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 35 to 85 m.s.m., on gravelly detritus among granitic rocks on open hillside, coll. I.M.L., July 1 and 5, 1952 (Nos. 6804, 6840, 6845). Fert.

Victoria Co.: near Sunset Cape North, alt. *circ.* 165 m.s.m., on detritus over granite rocks on previously burnt-over hillside, coll. I.M.L., July 31, 1952 (No. 6966). Fert..

Lecidea helvola (Körb.) Th. Fr.

Victoria Co.: Baddeck, on trees in woods, coll. J. Macoun, July 9, 1898, as intermixture with *Pertusaria amara*, *P. velata*, an indeterminable *Pertusaria*-species, and *Ochrolechia androgyna*, the whole recorded in Macoun's Catalogue, p. 119, under *Pertusaria velata*. Fert.—Franey Mountain trail near Ingonish, alt. *circ.* 165 m.s.m., on lower trunk of *Fagus* beside trail through mixed woods, associated with *L. albofuscescens*, coll. I.M.L., Aug. 6, 1952 (No. 6998 pr. p.). Fert.

Spores in both these specimens 10 to 15 x 3 to 4 μ.

Lecidea recensa Stirt.

F. **arcuatula** (Arn.) M. Lamb, **n. comb.** (Syn. *Biatora arcuatula* Arn. in Flora, LXXI, 1888, p. 107).

Inverness Co.: Cape Breton Highlands National Park, between Cheticamp and Cap Rouge, alt. *circ.* 20 m.s.m., on a sandstone block in open spruce scrub near the shore, coll. I.M.L., July 1st, 1952 (No. 6805). Fert.

Cape Breton Co.: Mainadieu, abundant on cliff face about 10 m. above the sea, coll. I.M.L., July 23, 1952 (No. 6916). Fert.

The writer has previously shown (M. Lamb, 1938, p. 157) that *Lecidea recensa* Stirt. is conspecific with *L. arcuatula* (Arn.) Hue, and has priority as the earlier specific epithet. The typical species, as described by the writer, loc. cit., and by Magnusson, 1925, 1935 (under *L. arcuatula*) has a pale, whitish-grey, ash-grey or cream-coloured thallus. In the f. *arcuatula*, as stated in Arnold's original description, the thallus is olivaceous-brown (or greyish-brown). *L. recensa* differs from *L. cyathoides* Ach. (Syn. *L. rivulosa* Ach.) in the smaller apothecia (0·5 to 0·8 mm. diam.) and the narrower spores (8 to 14 x 3·0 to 4·5 μ).

Lecidea uliginosa (Schrad.) Ach.

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on humus with *Cladoniæ* in a clearing of the woods, coll. I.M.L., June 16, 1952 (No. 6694). Fert.

Lecidea varians Ach.

Inverness Co.: Margaree, on *Acer* and *Fagus*, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 146, *s.n. Biatora Paddensis*). Fert.

Victoria Co.: Baddeck, on *Alnus*, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 146, *s.n. Biatora varians*). Fert.

An easily recognizable species on account of the characteristic thin, virescent or yellow-greenish, subgranulate thallus plentifully decussated with black hypothalline lines, and the minute, waxy-reddish or fuscescent, often irregular apothecia; cf. Merrill, Lich. Exs. Nos. 172, 173, *s.n. Biatora varians*. *L. paddensis* (Tuck.) Zahlbr. is a quite different species, with a dispersedly granulose thallus, not decussate by hypothalline lines, and larger, more regular, darker reddish apothecia (type-specimen seen in herb. Tuckerman, Farlow Herb.).

Lecidea vernalis (L.) Ach.

Inverness Co.: Margaree, on mosses on rocks, coll. J. Macoun, July 20, 1898 (Macoun, 1902, p. 144, *s.n. Biatora vernalis*). Fert.

Apothecia smaller and lighter coloured than usual in this species (0·25 to 0·50 mm. diam., yellowish-brown to pale brown); the spores are all simple, and hence the plant is not referable to the f. *subduplex* Nyl. In the apothecia the specimen strongly resembles *L. helvola*, but the occurrence on moss indicates rather *L. vernalis.*

Lecidea (Eulecidea) **albidocinerella** (Vain.) Vain.

Inverness Co.: Craigmore, alt. *circ.* 150 m.s.m., on rock outcrop in pasture near the sea, coll. I.M.L., June 15, 1952 (No. 6660). Fert.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of stones and rocks on site of the fortifications near the seashore, exposed position, associated with *Parmelia saxatilis* and *P. sulcata* and *Rhizocarpon disporum*, coll. I.M.L., July 19, 1952 (Nos. 6902 pr. p., 6903 pr. p., 6904 pr. p., 6905). Fert.

New to Canada. Previously known from Finland and Sweden. It is possible that some Canadian records under other names may refer to this species, e.g. "*Lecidea enteroleuca*" by Arnold, 1896, p. 326, from Newfoundland, and "*Lecidea sublatypea*" by Merrill in Ottawa Naturalist, XXVII (1913), p. 121, from Vancouver Island. It seems to be an aërohaline species found in maritime localities, although the Swedish specimen mentioned by Magnusson in Ark. f. Bot. XXXIIIA, No. 1 (1946), p. 46, was not found near the sea.

A good deal of confusion has prevailed regarding the small species composing the *Lecidea elæochroma-goniophila*-group (*L. elæochroma sensu* Th. Fr. Lich. Scandin.), and Magnusson's key to these species (Magnusson, 1945) has proved very useful in extricating them. There are, however, a number of species still not clearly understood. The following key and descriptions deal with the species which run down to the names *incongruella, subincongrua* and *latypiza* on pp. 125-126 of Magnusson's key, loc. cit., and are based on a study of the type or authentic specimens.

1. Epithecium inspersed with granules. Apothecia greyish-black. Paraphyses not or hardly thickened at tips. .*L. incongruella* Vain.

1a. No granules in epithecium. Apothecia pure black, rarely reddish-black. Paraphyses ± capitate at tips. . . . . .2.

2. Thallus (at least in places) $CaCl_2O_2$ + red, under microscope $CaCl_2O_2$ + orange mist. . . . . .3.

2a. Thallus $CaCl_2O_2-$, also under microscope. . . . . .4.

3. Thallus scanty, very thin, of minute scattered granules. Outer part of exciple purplish-fuliginous. Epithecium fuliginous, not distinctly æruginose. . . . .*L. distratula* Zahlbr.

3a. Thallus thickish, cracked-areolate, with ± plane areolae. Outer part of exciple dark sordid green. Epithecium æruginose. . . . .*L. subincongrua* Nyl.

4. Hymenium 75 to 85 μ high, with asci 65 to 80 μ long. Spores 11·0 to 13·5 x 6·8 to 8·5 μ. Thallus crowdedly areolate-verruculose, up to 0·5 (−0·8) mm. thick. . . . .*L. pertingens* Nyl.

4a. Hymenium 50 to 75 μ high, with asci 45 to 50 μ long. Spores narrower, 10·0 to 13·5 x 5·5 to 6·5 μ. Thallus thinner, more dispersed, not over 0·2 mm. thick..........................5.

5. Thallus of small grain-like verruculæ. Hypothecium strongly fulvous-brown (at least in lower part), the upper part of ± vertically parallel hyphæ.........*L. albidocinerella* (Vain.) Vain.

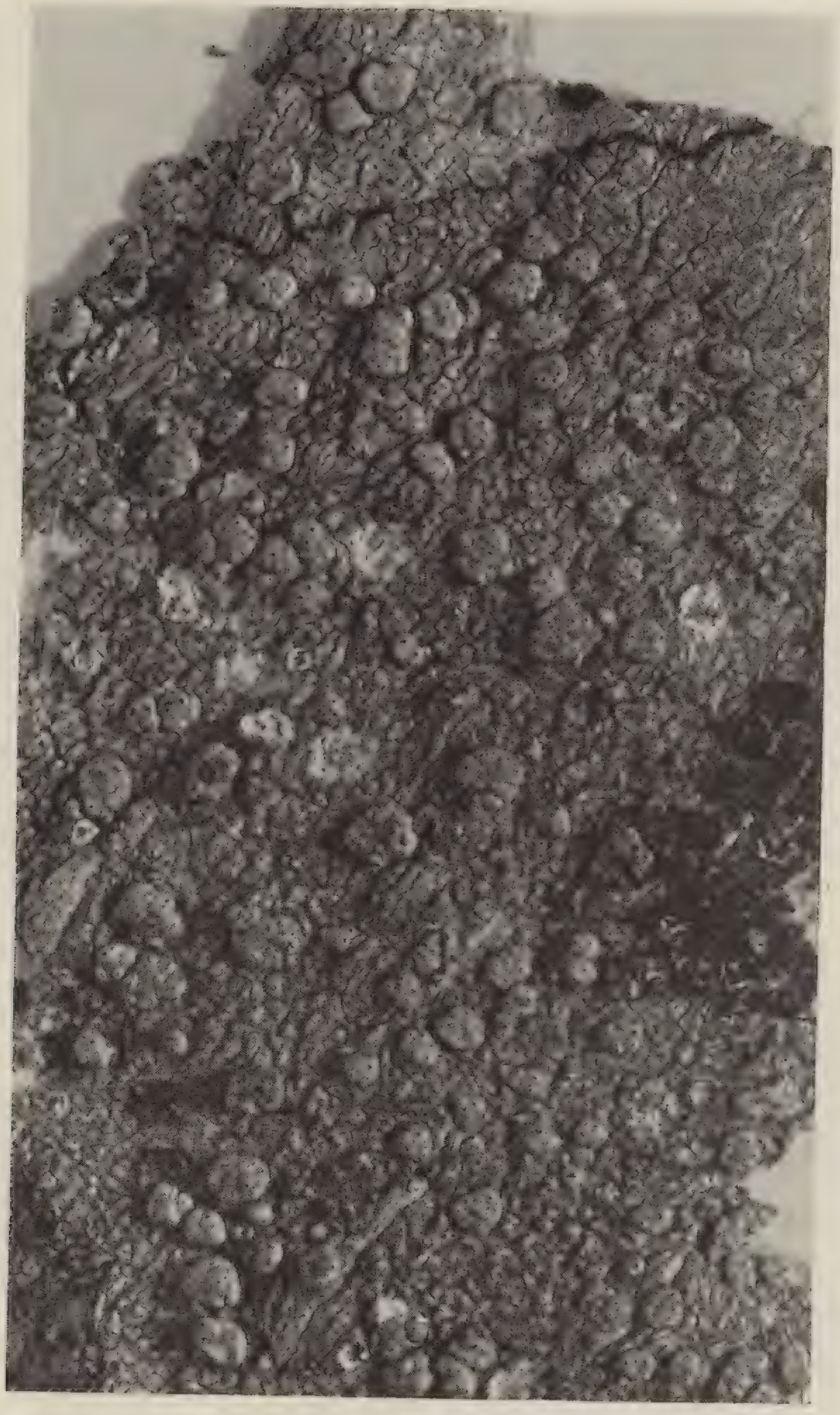
5a. Thallus granulose-areolate, with irregular, ± convex but not distinctly grain-like areolæ. Hypothecium faintly sordid yellowish (isabelline) or partly fulvescent-brownish (not strongly fulvous-brown), the upper part not of vertically parallel hyphæ.. ....*L. latypiza* (Nyl.) Nyl.

L. incongruella Vain. in Ark. f. Bot. VIII, No. 4 (1909), p. 133; Magnusson, 1945, p. 127.

Revision of the type-specimen from Siberia, Pitlekai, coll. Almquist, 1878-79 (Vega Exped.), from a small portion remitted from herb. Vainio:

On smooth, ± ferruginous, apparently quartzitic rock. Thallus of dispersed, yellow-whitish ("osseo-albidis") granules, which are regularly grain-like or subglobose, very minute, 0·05 to 0·10 mm. diam., matt. No hypothallus seen. Thallus (crushed out under microscope) KHO + slight yellow mist, $CaCl_2O_2$ − (C + orange, acc. to Magn., 1945, p. 127 !). The single apothecium in the fragment sent 0·6 mm. diam., round, sessile, constricted below, slightly convex, without distinct margin, blackish (not pure black, blacker when moistened, but still of a somewhat greyish-black colour), matt, naked.

Exciple developed at sides and for a short distance only below apothecium, 35 to 70 μ thick, not pigmented or in places only ± gradually sordid æruginose in its outer half, the inner hyphæ colourless, radiating, indistinct, gelatinized, thick-walled, interspersed with radiating streaks of sordid yellowish, ± granular substance; these inclusions dissolve in KHO, with slight yellow mist, leaving the exciple clear and ± colourless. Hypothecium 135 to 190 μ deep, in upper two-thirds fulvous or brownish-yellow, of indistinct, ± vertical hyphæ, in lower third darker fulvous- or reddish-brown and of indistinctly paraplectenchymatic structure, the cells becoming elongated-prosoplectenchymatic outwards at the sides. Hymenium 65 to 80 μ high, in uppermost 8 to 12 μ with an inspersed epithecium of dark sordid yellow-brownish granules, otherwise colourless and hyaline or with only a very faint æruginose tinge in the upper part immediately below the granulose epithecium; here and there with streaks of sordid yellowish-grey granules between the paraphyses. Paraphyses discrete, slender, filiform, sinuose, simple or sparingly branched, not articulated, 0·8 to 1·2 μ thick, the apices not pigmented and not or only slightly thickened (not over 2 μ). Asci clavate, 55 to 60 x 11·0 to 13·5 μ, the apex thickened to 6 to 10 μ, not distinctly invaginated. Spores 8næ, biseriate in ascus, ellipsoid, with usually distinct wall about 0·5 μ thick, 11 to 15 x 5·5 to 6·5 μ.—In KHO the granulose epithecium dissolves completely with slight yellow mist, leaving the upper part of the hymenium colourless or very faintly æruginose-greenish. Hypothecium KHO + dark reddish. Hymenium I + dark blue.



Pertusaria neoscotica M. Lamb, type-specimen. At the upper edge part of thallus of *Melanaria macounii* var. *meizotoca*. Coll. J. Macoun, 1898. x 4.

Obviously quite distinct from *L. albidocinerella* Vain. on account of the ± unpigmented, streaky-inspersed exciple, more slender paraphyses not or only slightly thickened and not distinctly pigmented at the tips, and above all by the insperse epithecium of sordid dark granules. Neither Vainio, *descr. orig.*, nor Magnusson, 1945, p. 127, mention the granulose epithecium, and Magnusson states the thallus to be $CaCl_2O_2$ + orange. And yet all these observations have been made on the same single type specimen. Is there perhaps an admixture of another species?*

L. distratula Zahlbr., Cat. Lich. Univ. III (1925), p. 566. (Syn. *L. distrata* Arn. in Flora, LXVIII, 1885, p. 239, nomen nudum, in Verh. Zool.-Bot. Ges. Wien, XXXVII, 1887, p. 100, *cum descr.*, quoting Arn. Exs. 941a and b; *non L. distrata* Nyl., 1876, = *Buellia distrata* Zahlbr. *L. latypiza* f. *distrata* H. Magn., 1945, p. 129. *L. latypea* var. *distratula* Frey in Ber. Schweiz. Bot. Ges. XXXVII, 1928, p. 116, *non vidi*).

Revision of syntype-specimen Arn. Lich. Exs. No. 941b from Tirol, Sägmühlen bei Paneveggio, on porphyritic rock in woods, coll. Arnold, 1882, in Farlow Herb.:

Thallus effuse, widespread, scantily developed, consisting of scattered or partly contiguous, very minute, whitish or cream-coloured verruculæ less than 0·1 mm. diam., the bare rock surface everywhere visible in between them. No distinct hypothallus. Thalline granules macroscopically KHO + good yellow, $CaCl_2O_2$ (at least in places) + orange-red; crushed out under microscope, KHO + distinct yellow mist, $CaCl_2O_2$ + distinct orange mist, I −. Apothecia numerous, scattered, sessile on the rock among the thallus-granules, round, well constricted at base, 0·5 to 0·7 (−0·9) mm. diam., a long time plane with thin, entire, slightly prominent, black, subnitid proper margin, finally becoming very slightly convex with the margin indistinct. Disk black or reddish-black, matt, smooth, not pruinose.

Exciple developed at sides and a long way round below apothecium, but interrupted for a distance of 100 to 250 μ at the centre; 65 to 110 μ thick, in outer half densely purplish-fuliginous and opaque, in inner half gradually paler, with streaks of purplish-brown pigment between the hyphæ; of distinct flabellate-radiate structure, with thick-walled, conglutinated hyphæ 3 to 4 μ thick. No granules present. Hypothecium up to 135 μ deep (at the open point of attachment also running down between the excipulum into the substratum), ± clearly divided into two parts: (a) a lower, colourless, hyaline part (perhaps referable to exciple) consisting of conglutinated, gelatinized, thick-walled hyphæ, only the thread-like lumina (up to 1 μ wide) visible, intertexted in various directions or at the

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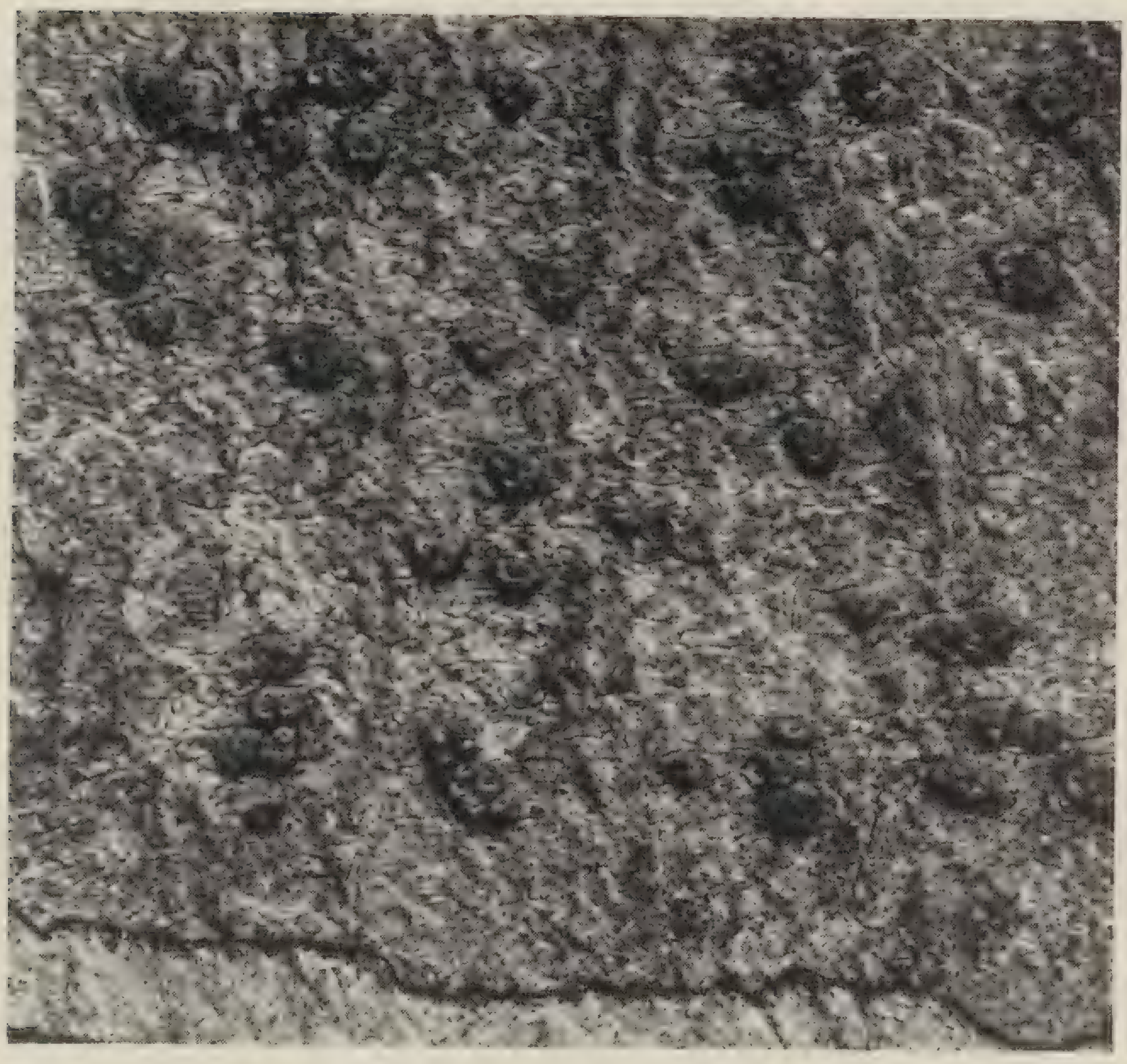
* The type material of *L. incongruella* in herbarium Vainio is preserved in two packets, Nos. 23985 and 23986 of Herb. Vain. The latter specimen has been annotated by Vainio "non typica". The description given here is based on the former specimen, No. 23985.

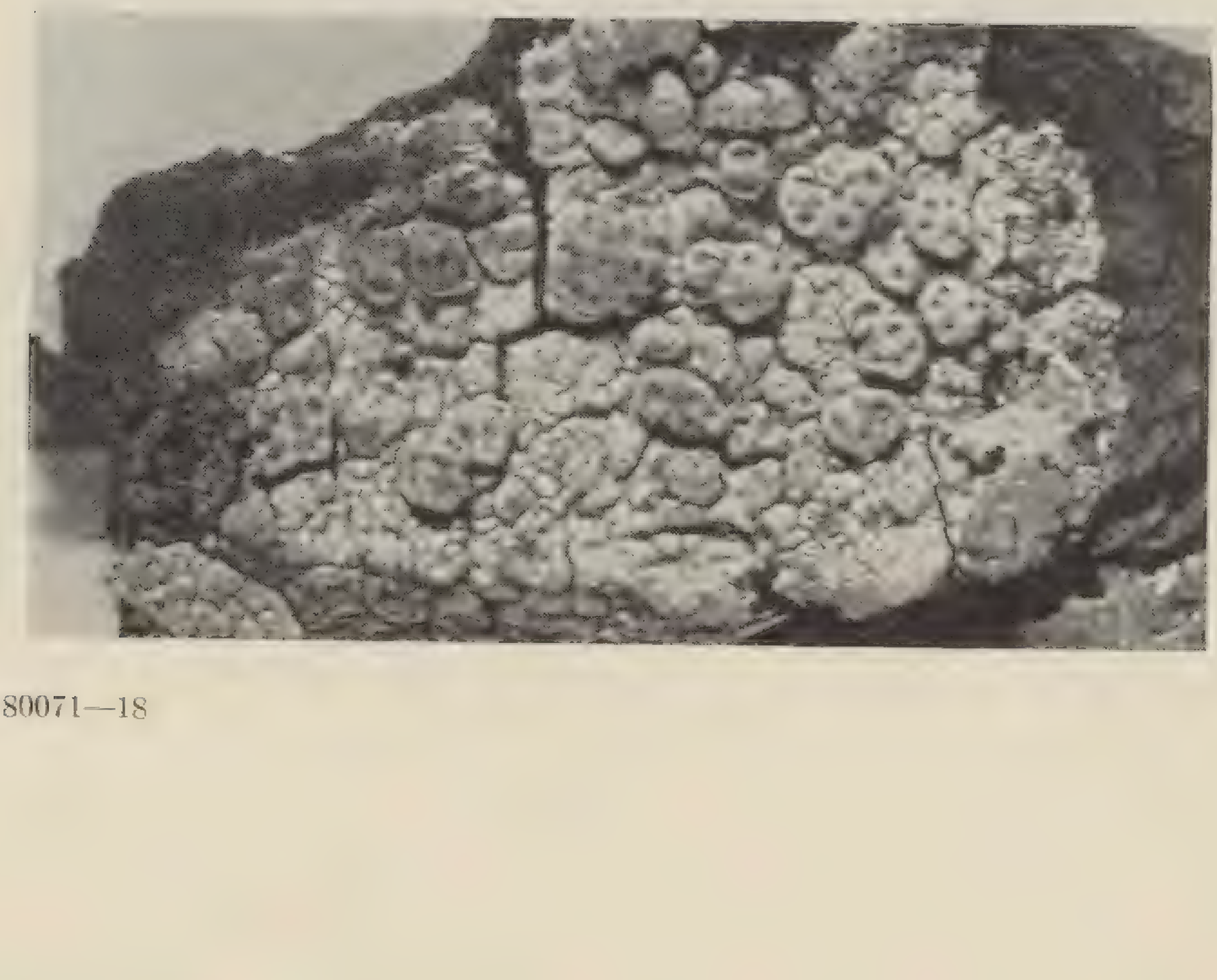
PLATE III

Above, *Melanaria macounii* M. Lamb, type-specimen. Coll. I. M. Lamb, 1952. x 4.

Below, *Melanaria macounii* var. *meizotoca* M. Lamb, type-specimen. Coll. J. Macoun, 1898. x 4.

PLATE III





sides ± horizontally parallel; and (b) an upper, faintly sordid yellowish or isabelline 65 to 80 μ consisting of indistinct, ± cellulose hyphæ 2 to 3 μ thick compactly intricated in various directions. Hymenium about 70 μ high, gradually sordid purplish-blackish, fumose-blackish, or indeterminately fuliginous (often with a faintly greenish tinge but not distinctly æruginose) in upper 10 to 14 μ, otherwise colourless and hyaline; no granules. Paraphyses discrete, simple or sparingly branched, about 1·5 μ thick, not articulated, at the tips clavate capitate up to 4 μ and there ± pigmented (sordid chalybeous or greenish-grey). Asci clavate, 58 to 65 x 10 to 15μ, with wall 1·0 to 1·3 μ thick at sides, at apex thickened up to 10 (−14) μ and there sometimes invaginated. Spores 8næ, biseriate, ellipsoid to broadly ellipsoid, 10·0 to 13·5 x 7 to 9 μ, the wall often distinct but thin, about 0·7 μ. Pycnidiospores (seen in crushed-out thallus) filiform, arcuate, 13 to 20 x about 0·5 μ.—Exciple and hypothecium KHO −; epithecium becomes pale brownish with KHO. Hymenium I + blue then greenish-blue (blue then vinose acc. to Arn. *descr. orig.*).

L. subincongrua Nyl. in Bull. Soc. Linn. Normand. VI (1872), p. 291; H. Magn., 1945, p. 127. (Syn. *L. continuior* Nyl. in Flora, LXX, 1877, p. 463, acc. to H. Magn., loc. cit.).

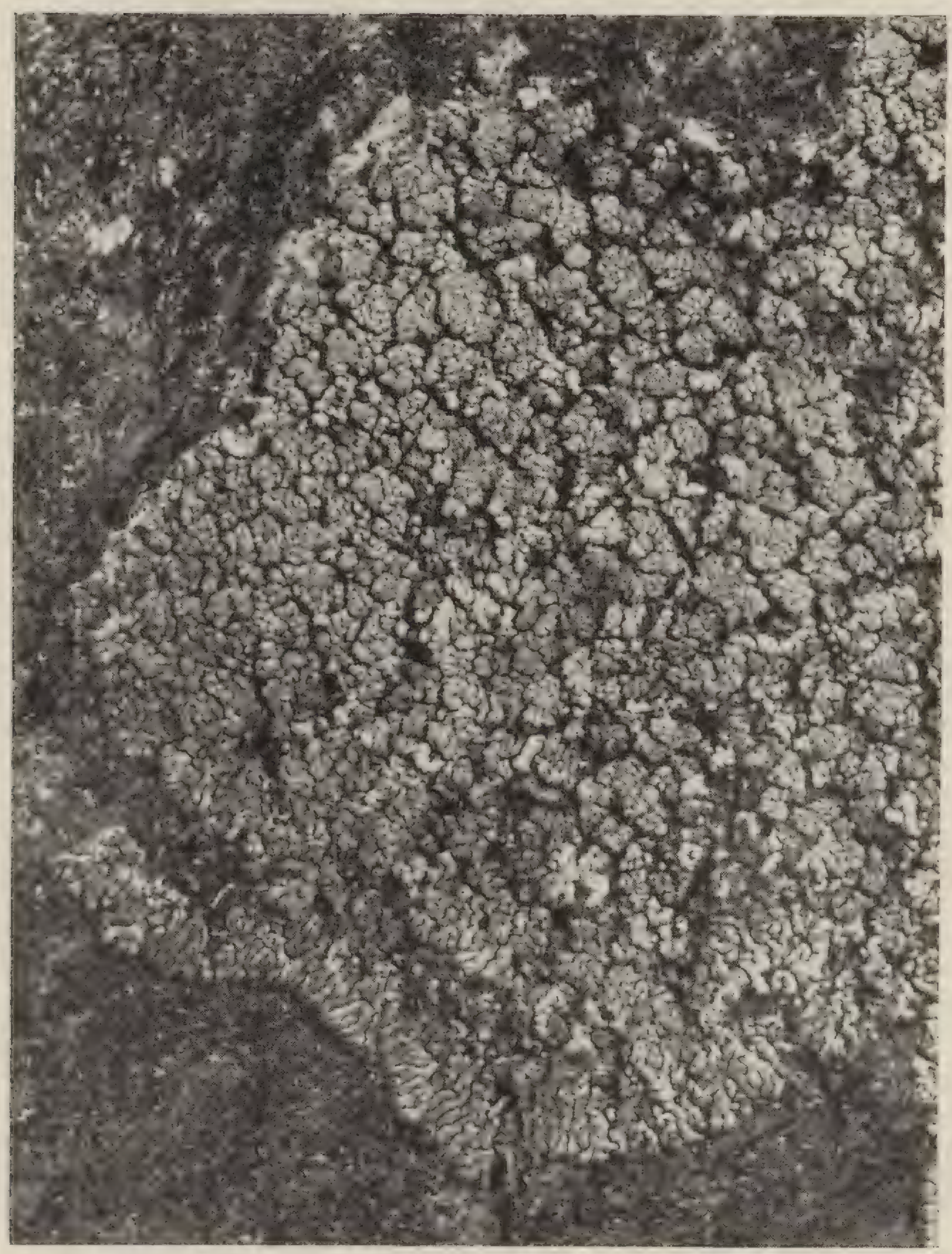
No material seen by me. Magnusson, loc. cit., records it from the Pyrenees (type locality), Italy, Hungary, Ireland, and Sweden.

L. pertingens Nyl. in Flora, LVII (1874), p. 313.

Revision of the type-specimen in herb. Nylander (No. 5066 post mortem Nylandri insertum) from Hungary, Transsylvania, Com. Hunyad, "ad saxa gneissacea circa lacum 'Zenoga' infra alpem Retyezát", alt. 6,000 feet, coll. Lojka, 1873:

Thallus effuse, in scattered or confluent and ± widespread patches, whitish-grey or sordid cream-coloured, crowdedly areolate-verruculose, the verrucose areolæ 0·10 to 0·25 (−0·30) mm. diam., often ± concrescent, and forming a partly diffract crust up to 0·5 (−0·8) mm. thick. Traces of a thin, effuse, black hypothallus visible here and there between the patches of thallus. Thallus macroscopically KHO + yellowish, $CaCl_2O_2$ −; crushed out under microscope KHO + distinct yellow mist, $CaCl_2O_2$ −, I −. Apothecia numerous, scattered or often crowded and contiguous, sessile on thallus, moderately constricted at base, round, 0·3 to 0·5 mm. diam., black, persistently plane with thin, entire, ± persistent, black, matt or subnitid proper margin; disk black, smooth, matt, naked.

Exciple developed at sides only, 50 to 78 μ thick, in outer 17 to 24 μ aeruginose-blackish, in inner part becoming gradually fulvous-brownish, purplish-brown, fulvous, or almost colourless (KHO + orange-reddish like the hypothecium); composed of indistinct, gelatinized and conglutinated hyphae (only the thin lumina visible) in distinct flabellate-radiating arrangement. No granules present. Hypothecium intense reddish-fulvescent or pale reddish-brown in section, conical, up to 170 μ deep in centre, at its base produced indeterminately downwards into the underlying thallus; its hyphae forming an indistinctly cellulose tissue with moderately thick-walled cells 3 to 4 μ diam., in the upper subhymenial 30 to 35 μ becoming vertically parallel. Hymenium 75 to 85 μ high, gradually æruginose-blackish in upper 10 to 17 μ, the rest faintly æruginose or ± colourless. No granules in hymenium. Paraphyses discrete, about 1·5 μ thick,



Lecanora (Placodium) microbola M. Lamb, part of the type-specimen. Coll. I. M. Lamb, 1952. x 4.

simple or rarely sparingly branched, not articulated, at tips swollen to 4 μ and ± dark æruginose-pigmented. Asci clavate, 65 to 80 x 12 to 17 μ, wall in young asci gelatinously thickened up to 3 μ, in mature asci thinner, at apex thickened up to 14 μ and often distinctly invaginated. Spores 8nae, biseriate, rather broadly ellipsoid, 11·0 to 13·5 x 6·8 to 8·5 μ, with usually distinct wall up to 0·7 μ thick.—Hypothecium KHO + orange-reddish, epithecium KHO − or more greenish. Hymenium I + blue.

In appearance very similar to the type material of *L. latypiza* Nyl., with which species it has been regarded (also by Nylander) as synonymous, but seems well distinct in the thicker and better developed thallus, higher hymenium, and broader spores.

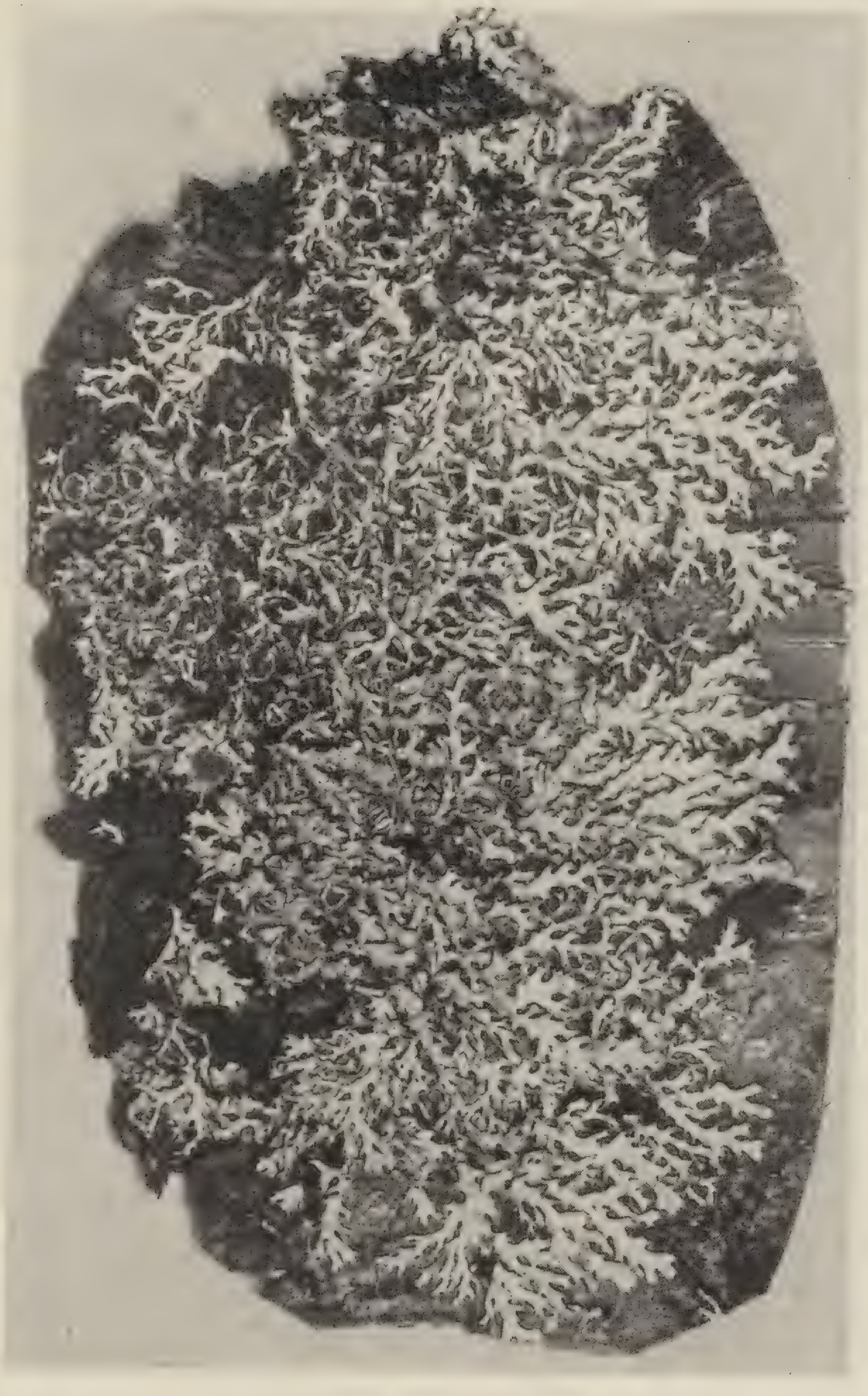
L. albidocinerella (Vain.) Vain., Lichenogr. Fennic. IV (1934), p. 266. (Syn. *L. incongruella* var. *albidocinerella* Vain. *apud* Räsänen in Medd. Soc. Fauna & Flora Fennic. XLVI, 1921, p. 171, nomen nudum).

Originally recorded, without description (*apud* Räsänen, loc. cit.) from Finland, Simo, Tiurasenkrunni, on marine stones, coll. V. Räsänen. Described for the first time, as a proper species, by Vainio, loc. cit. (1934), with two additional Finnish localities in Åbo, par. Naantaali, Luonnonmaa Island, and Pojo, Bålaskär, both by the sea.

Revision of the type-specimen from Simo, Tiurasenkrunni, coll. Räsänen, 1920 (No. 23989 in herb. Vainio) lent from Turku University:

On smooth quartzose rock. Thallus effuse, patchy, of contiguous, ash-grey, matt, tumid-verrucose granules 0·10 to 0·15 mm. diam. Hypothallus poorly developed, visible here and there under x10 lens at the margins of the thallus, black, minutely dendritic. Thallus (crushed out under microscope) KHO + strong yellow mist, $CaCl_2O_2-$, I−. Apothecia numerous, scattered or sometimes contiguous, sessile, slightly to moderately constricted at base, round, somewhat variable in size, 0·2 to 0·4 (−0·5) mm. diam., entirely pure black, matt, naked, at first plane with thin, entire, hardly prominent proper margin, then soon moderately to strongly convex and immarginate.

Exciple 35 to 70 μ thick, lateral but extending for some distance round below apothecium, where it becomes vague and merges into the lower hypothecium; at the sides of radiating structure, entirely heavily blackish-pigmented and ± opaque in section (without distinct æruginose or purplish tinge, KHO−), the conglutinated darkened hyphæ about 3·5 μ thick. Hypothecium fulvous-brown in thin section (the pigmentation somewhat patchy and irregular), 85 to 100 μ deep, in the lower third (basal exciple ?) darker brown; composed of indistinct gelatinized hyphæ 1·5 to 3·0 μ thick, vertical in the upper subhymenial part, variously intertexted in the lower part; KHO + more reddish. Hymenium 55 to 70 μ high, ± colourless or faintly brownish in the lower half, gradually æruginose in the upper half, the uppermost 6 to 12 μ gradually intensely æruginose-blackish (unchanged or slightly lighter in KHO), I + persistently blue. No granulose epithecium. Paraphyses discrete, simple or sometimes branched, not articulated, 1·2 to 1·5 (−2·0) μ thick, ± gradually thickened to 2 to 3 μ at the æruginose tips. Asci clavate, 45 to 50 x 10 to 12 μ, the apex thickened up to 10 μ with distinct invagination. Spores 8næ, ellipsoid, biseriate in ascus, 12·0 to 13·5 x 5·5 to 6·0 μ, often with distinctly visible wall about 0·8 μ thick.



Parmelia saxatilis var. *divaricata* Del. ex. Nyl. A specimen from Cape Breton, near Baddeck, on *Betula*, coll. I. M. Lamb, 1952 (No. 6858). Nat. size.

The writer also saw a piece of the specimen of *L. albidocinerella* mentioned by Vainio, loc. cit. (1934), from Pojo, Bålaskär, coll. Brenner, 1920 (No. 23987 in herb. Vain.), and found it to be identical, although differing slightly in a few unimportant respects (more distinct hyphæ of the hypothecium, which runs down into the subtending thallus to a depth of up to 250 μ). The writer's Cape Breton material agrees very well with both these authentic specimens.

The macroscopic KHO reaction, as with other species of the group, is variable and not a reliable taxonomic criterion; in specimens from Cape Breton, Nos. 6903 pr. p., 6904 pr. p., and 6905 give only a weak indistinct yellow reaction with KHO applied to the thallus, but in No. 6902 pr. p., from the same extensive population, the yellow reaction is fairly distinct. All the specimens give more or less yellow mist with KHO in crushed-out preparations under the microscope.

L. latypiza (Nyl.) Nyl., Lich. Nov. Zeland. (1888), p. 103; H. Magn., 1945, p. 128. (Syn. *L. parasema* ***L. latypiza* Nyl. in Bull. Soc. Linn. Normand., sér. 2, VI, 1872, p. 310. *L. fennica* Räs. in Ann. Bot. Vanamo, XII, 1939, p. 166, *fide* H. Magn. in Svensk Bot. Tidskr. XLVI, 1952, p. 198.

There are three type-specimens from Collioure in the Pyrenees, coll. Nylander, 1872, in Herb. Nylander, Nos. 19531-33, and one of these, No. 19532, has been taken as the lectotype; the following description is made from it:

Thallus effuse, in scattered patches, whitish-grey, crowdedly or dispersedly granulose-areolate, the areolæ or granules 0·1 to 0·2 mm. diam., irregular, ± convex but not regularly subglobose. No hypothallus. Thallus (crushed out under microscope) KHO + slight yellow mist, $CaCl_2O_2$ −, I −. Apothecia numerous, scattered or sometimes several confluent, 0·2 to 0·3 (−0·35) mm. diam., adpressed-sessile, round, slightly constricted at base, black, matt, naked, ± persistently plane with a very thin, entire, non-prominent, black proper margin, occasionally becoming slightly convex and immarginate.

Exciple developed at sides only, 25 to 35 μ thick, entirely æruginose-blackish in section or ± colourless internally and gradually æruginose-blackish in outer 10 to 17 μ; of indistinct gelatinized hyphæ 2 to 3 μ thick in ± flabellate-radiating formation; no granules. Hypothecium sordid yellowish (isabelline), or partly unevenly fulvescent-brownish (not fulvous-brown), KHO + unevenly reddish-fulvescent, about 70 μ deep, but without distinct limit downwards, where it merges gradually into the substratum; of indistinctly cellulose structure, its hyphæ forming isodiametric, ± rounded and moderately thick-walled cells 3 to 5 μ diam. right up to the base of the hymenium (no upper subhymenial part of vertical hyphæ). Hymenium about 50 μ high, densely and ± abruptly æruginose-blackish in uppermost 8 to 12 μ (KHO−), otherwise ± colourless or pale sordid æruginose; no granules present. Paraphyses discrete, 1·2 to 1·6 μ thick, simple or sparingly branched, not articulated, at the tips clavate-capitate up to 4 μ and there ± overlaid with dark æruginose pigment. Asci clavate, 45 to 50 x 9·0 to 13·5 μ, the wall thickened up to 8 or 9 μ at apex. Spores ellipsoid, 10·0 to 13·5 x 5·5 to 6·0 μ, with ± distinct wall about 0·7 μ thick.—Hymenium I + blue.

The other two specimens from the same type locality mentioned above are quite similar.

According to Vainio, Lichenogr. Fennic. IV (1934), p. 255, this species is identical with *L. stigmatea* f. *granulosa* (Arn.) Vain.

L. latypiza seems to have a wide distribution from Arctic Siberia through Central and Western Europe to North Africa, but some of the records probably refer to other species, as in the case of *L. pertingens* mentioned above. It has been recorded from Canada, Vancouver Island, by Merrill in Ottawa Naturalist, XXVIII (1914), p. 35; the writer has not seen the specimen.

Lecidea cinereoatra Ach.

Inverness Co.: Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on stones in sparsely wooded pasture, associated with *Rhizocarpon plicatile*, coll. I.M.L., June 28, 1952 (No. 6764 pr. p.). Fert.

Differs from *L. macrocarpa* (DC.) Steud. chiefly in the æruginose-blackish (not olivaceous-brown) colour of the epithecium; see the writer's revision of the Acharian syntype (M. Lamb, 1938), with icon. It is closely related to *L. hydrophila* Fr., but that species has a more continuous thallus and intensely emerald or blue-green epithecium (cf. Magnusson, 1951, p. 71).

Lecidea confluens (Web. ?) Ach.

Victoria Co.: About 8 miles up the Clyburn Valley from Ingonish, alt. *circ.* 420 m.s.m., on a sloping rock in wooded gorge of the stream, near a waterfall, coll. I.M.L., Aug. 9, 1952 (No. 7010). Fert.

Lecidea crustulata (Ach.) Sprgl.

Inverness Co.: Craigmore, alt. *circ.* 100 m.s.m., on metamorphic stone in open mixed woods, coll. I.M.L., June 13, 1952 (No. 6650). Fert.—Craigmore, alt. *circ.* 235 m.s.m., on dry stones at side of river bed in mixed woods, coll. I.M.L., June 19, 1952 (No. 6703). Fert.—Vicinity of Margaree Forks, alt. 35 to 85 m.s.m., on stones on roadside bank under spruce trees, coll. I.M.L., June 23 and 25, 1952 (Nos. 6747, 6759). Fert.

Victoria Co.: Baddeck, on pebbles by roadside, coll. J. Macoun, July 29, 1898 (Macoun, 1902, p. 157, *s.n. L. enteroleuca*). Fert.—About 8 miles up the Clyburn Valley from Ingonish, alt. *circ.* 430 m.s.m., on rock in wooded gorge of a stream, coll. I.M.L., Aug. 9, 1952 (No. 7011). Fert.

Cape Breton Co.: vicinity of North Sydney, alt. *circ.* 85 m.s.m., on block of sandstone in heathy pasture with scattered birch trees, coll. I.M.L., Aug. 19, 1952 (No. 7013). Fert.

Nos. 6703 and 6759 from Inverness Co. have the very thin thallus in orbicular patches, with the apothecia ± in lines with a vaguely concentric arrangement; they are probably referable to the f. *subconcentrica* Stein.

F. **minutissima** (Vain.) Vain.

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on dry stones at side of river bed in mixed woods, coll. I.M.L., June 19, 1952 (No. 6701). Fert.—Vicinity of Margaree Forks, alt. 35 to 85 m.s.m., on loose stones on roadside banks, coll. I.M.L., June 22, 23, and 25, 1952 (Nos. 6736, 6748, 6758). Fert.

Thallus evanescent. Apothecia minute, 0·20 to 0·35 (−0·40) mm. diam., persistently plane and marginate. Hymenium (55−) 70 to 80 μ high, I + blue then dark greenish-blue, and asci becoming wine-red. Spores 10·0 to 13·5 x 5·0 to 6·8 μ.

Lecidea cyanea (Ach.) Röhl.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 50 to 65 m.s.m., on granitic and metamorphic blocks on hillside and in talus slope at foot of cliffs, abundant, often associated with *Lecanora* (*Aspicilia*) *cinerea*, *Rhizocarpon distinctum* and *Rh. geographicum*, coll. I.M.L., June 30 and July 3, 1952 (Nos. 6785 pr. p., 6825, 6827). Fert.—Same locality, alt. *circ.* 50 m.s.m., on a metamorphic rock in partial shade of trees in a stream-gully, coll. I.M.L., July 3, 1952 (No. 6831). Fert.

Victoria Co.: Cape North, Gray Glen, Burnt Mountain, on stones of scree, associated with *Rhizocarpon geographicum* and *Lecanora intricata*, coll. J. S. Erskine, July 10, 1952 (No. 52 C 2074 pr. p.). Fert.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of stones on site of the inner fortifications, common, coll. I.M.L., July 19, 1952 (No. 6893). Fert.

The specimens from Louisburg and Cape North give a good KHO + yellow then red reaction, but Nos. 6825 and 6827 from Cape Breton Highlands have the thallus KHO + persistently yellow; in the former the medulla is KHO −, in the latter it is in places KHO + faint reddish. An obvious transition is therefore seen to "*Lecidea tesselata*" Flk., which is nothing more than a chemical strain or phase of *L. cyanea*, with which it is included as a synonym by Zahlbruckner in Cat. Lich. Univ. III (1925), p. 553. No. 6831 presents a very atypical appearance owing to the thallus having been eroded by snails or other animal agencies; smooth and plane as if rubbed down, reticulate-rimose, with greenish, almost furfuraceous surface, because of exposure of the algal stratum; the thallus externally and internally KHO −, but the medulla gives the blue reaction with iodine.

Lecidea erratica Körb.

Inverness Co.: vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on stones on earth bank at roadside, occurring as intermixture with *Rhizocarpon plicatile*, coll. I.M.L., June 22, 1952 (No. 6734 pr. p.). Fert.

Victoria Co.: Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on stone on soil bank at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6871). Fert.

Lecidea furvella Nyl.

Cape Breton Co.: vicinity of North Sydney, alt. *circ.* 85 m.s.m., on a sandstone rock in open heathy pasture, forming extensive black patches, coll. I.M.L., Aug. 19, 1952 (No. 7014). Ster.

New to Canada. The blackish, thick, areolate, isidiose-furfuraceous thallus resembles that of *Placynthium asperellum* (Ach.) Trev., but the symbiotic algæ are protococcoid. The writer is indebted to Dr. A. H. Magnusson for the determination.

Lecidea lapicida (Ach.) Ach.

F. **ochracea** (Nyl) Vain.

Victoria Co.: Cape North, Gray Glen, Burnt Mountain, on stones of scree, coll. J. S. Erskine, July 10, 1952 (No. 52 C 2073). Fert.

Lecidea macrocarpa (DC.) Steud.

Var. **steriza** (Ach.) Vain.

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on stone in hillside pasture, coll. I.M.L., June 16, 1952 (No. 6692). Fert.—Vicinity of Margaree Forks, alt. *circ.* 85 m.s.m., on a large sandstone boulder at side of road through mixed woods, coll. I.M.L., June 23, 1952 (No. 6746). Fert.—Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 35 m.s.m., on exposed granitic rocks, coll. I.M.L., June 30, 1952 (No. 6786). Fert.

Victoria Co.: Vicinity of Cape North, alt. *circ.* 65 m.s.m., on boulder beside trail through spruce woods, coll I.M.L., Aug. 1, 1952 (No. 6968). Fert.

F. **caesioconvexa** (Vain.) Zahlbr.

Victoria Co.: Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on a conglomerate rock by the roadside, associated with *Stereocaulon pileatum*, coll. I.M.L., July 14, 1952 (No. 6870). Fert.

Thallus sordid cinereous, very thin, almost evanescent, scurfy. Apothecia 1·0 to 1·5 mm. diam., faintly pruinose, finally convex. Hymenium (90–) 100 to 120 μ high. Spores (13·5–) 15 to 18 (–18·5) x (5–) 6·0 to 6·5 (–7) μ.

Lecidea plana (Lahm) Nyl.

Inverness Co.: Margaree, on rocks, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 156, *s.n. L. albocærulescens*). Fert.—Craigmore, alt. *circ.* 50 m.s.m., on metamorphic block on open hillside, coll. I.M.L., June 12, 1952 (No. 6621). Fert.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on exposed granitic rocks on open hillside, common, coll. I.M.L., July 5, 1952 (No. 6849). Fert.

Lecidea tenebrosa Flot.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on blocks of talus slope at foot of cliffs, coll. I.M.L., July 5, 1952 (No. 6844). Fert.

Thallus dark grey or brownish grey, verrucose-areolate, on a well developed black hypothallus; externally KHO –, $CaCl_2O_2$ –, medulla $CaCl_2O_2$+ red, KHO–, I–. Apothecia adpressed-sessile, plane, marginate, up to 0·7 mm. diam. Hypothecium pale yellowish-brown or almost colourless. Hymenium 65 to 95 μ high, blue-green-blackish in uppermost part, without any violet epithecium. Paraphyses completely discrete. Spores 10 to 14 x (5–) 6 to 8 μ. No pycnoconidia found.

The red $CaCl_2O_2$ reaction of the medulla may not be constant in this species but has been found in Swedish and Icelandic specimens examined. Vainio in Lichenogr. Fennic. IV (1934), p. 246, states that the hymenium is about 120 to 140 μ high in *L. atrocinerea* (= *tenebrosa*), but in the specimens seen by the writer it does not exceed 95 μ; also Magnusson in his *Lecidea*-key (1952) gives the height of the hymenium in *L. tenebrosa* as 85 μ.

It is possible that *Lecidea labradorica* Arn. ("Labrador", 1896, p. 13) may belong to the present species. The type-specimen has apparently been lost (see Magnusson, 1935, p. 14), but the description given by Arnold accords fairly well with *L. tenebrosa*, except that the medulla is stated to be "leviter amyloid.". In the closely related species *L. somphotera* Vain. (Syn. *L. epiiodiza* Nyl.) the medulla may occasionally be weakly amyloid (cfr. Vainio, 1909, p. 138), and possibly a similar faint iodine reaction may occasionally be found in *L. tenebrosa* also.

L. tenebrosa is mentioned by Nichols, 1918, p. 327, as occurring on the shingle of the upper beach in the N.E. parts of the island.

Lecidea tumida Mass. (Syn. *L. sorediza* Nyl.)

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of stones on site of the fortifications, abundant and widespread, but completely sterile, coll. I.M.L., July 19, 1952 (No. 6906).

Soredia numerous, minute, round, dark grey to blackish, whitish-marginate, slightly prominent. Medulla I + violet-blue. On account of the dark soredia the thallus may resemble that of *L. negroleprosa* (Vain.) H. Magn., but the medulla is I +.

Mycoblastus melinus (Kphbr.) Hellb.

Victoria Co.: Cape North near Bay St. Lawrence, alt. *circ.* 330 m.s.m., on trunk of *Betula* in open mixed woods, coll. I.M.L., Aug. 3, 1952 (No. 6971). Fert.

Distinguished from *M. sanguinarius* var. *alpinus* by the 2-spored asci. Anders (1929) considers it to be only a form of *M. sanguinarius* var. *alpinus.*

Mycoblastus sanguinarius (L.) Norm.

Victoria Co.: Baddeck, on trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 153, *s.n. Heterothecium sanguinarium*). Fert.—Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., on granitic boulder of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6978). Fert.—Same locality, alt. *circ.* 330 m.s.m., on branch of standing dead *Picea* in mixed woods, coll. I.M.L., Aug. 3, 1952 (No. 6981). Fert.

All specimens are the typical form of the species (= var. *endorhodus* (Th. Fr.) Stein). Two other specimens on Macoun's mount of "*Heterothecium sanguinarium*" are *Bacidia Schweinitzii.*

Catillaria (Biatorina) **Griffithii** (Sm.) Malme

Inverness Co.: Craigmore, alt. 85 to 135 m.s.m., on trunks of *Abies* and *Picea* in open mixed woods, coll. I.M.L., June 12 and 15, 1952 (Nos. 6620, 6662). Fert.

Victoria Co.: Baddeck, on *Picea*, coll. J. Macoun, July 29, 1898 (Macoun, 1902, p. 147, *s.n. Biatora mixta*). Fert.

Catillaria (Eucatillaria) **grossa** (Pers.) Körb.

Victoria Co.: Baddeck, on *Fraxinus*, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 153, *s.n. Heterothecium grossum*). Fert.

In Zahlbruckner's Cat. Lich. Univ. II (1923), p. 527, and VIII (1932), p. 228, this species is called *Catinaria leucoplaca* (DC.) Zahlbr., based on *Patellaria leucoplaca* DC. (1805). But Zahlbruckner apparently overlooked Th. Fries' remark in Lich. Scandin. (1874), p. 582: "*Lecidea leucoplaca* DC. Fl. fr. ex ipsius herbario est *L. elaeochromae* forma." The earliest subsequent reliable epithet seems to be *Lecidea grossa* Pers. ex Nyl. (1856).

C. grossa is an austral element in the boreal lichen flora, belonging to the group of large-spored *Catillariae* which has its centre of distribution in the temperate and cooler southern hemisphere, chiefly New Zealand and South America. It seems to be not uncommon on the Atlantic Coast of North America from Maine to Newfoundland, according to the list of localities given by Merrill in Bryologist, XVI (1913), p. 78. Fink, 1935, p. 220, records it also from Nebraska. In Europe it occurs from Scandinavia to the Iberian Peninsula.

Catillaria Laureri Hepp

Inverness Co.: Margaree, on *Fagus*, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 147, *s.n. Biatora Laureri*). Fert.—Craigmore, alt. *circ.* 135 m.s.m., on trunk of *Fagus* in mixed woods, coll. I.M.L., June 15, 1952 (No. 6669). Fert.

The symbiotic alga of this species is *Trentepohlia* (well seen in the writer's freshly gathered material), and for this reason it has been removed by Degelius, 1941a, p. 12, to the genus *Catinaria.*

Bacidia chlorantha (Tuck.) Fink

Victoria Co.: Baddeck, on bark of *Alnus* and *Betula*, coll. J. Macoun, July 8, 1898, associated with *Buellia parasema* (Macoun, 1902, p. 162, *s.n. Buellia parasema*). Fert.—Near Sunset Cape North, alt. *circ.* 65 m.s.m., on trunk of *Quercus* in light mixed woods, coll. I.M.L., July 31, 1952 (No. 6964). Fert.

An endemic North American species characterized by the bright green or yellow-green thallus (like that of *Lecidea olivacea*), the reddish-brown to nigrescent, flexuose-marginate apothecia with ± colourless hypothecium and brown epithecium, and polysporous asci. See the remarks of Degelius, 1940, p. 24, and of Thomson, 1951, p. 31.

The number of spores in the ascus is difficult to estimate, even after treatment with HNO_3; probably Tuckerman's estimate of about fifty is not far short of the mark. They have been described as 23 to 34 x 2 to 3 μ (Tuckerman, 1888, p. 50) or 20 to 35 x 2 to 3 μ (Fink, 1935, p. 229, Thomson, 1951, p. 31). These measurements seem to be wrong, which is not surprising, for the spores are hard to see and easily confused with detached paraphyses; in Tuckerman's type-specimen from Hingham, Mass., as well as in the writer's No. 6964, the mature spores are acicular-anguilliform, straight or usually slightly curved, narrowly tapering and acuminate at one end, obsoletely 3- to 4-septate or often eseptate, (17−) 22 to 27 (−30) x 1·5 to 2·0 μ.

The brown epithecium is KHO−, HNO_3−. In fresh material the thallus is green or yellowish-green, but in old herbarium specimens, such as Tuckerman's type and Macoun's specimen, it becomes cream-coloured to dull fuscescent.

Bacidia hypnophila (Ach.) Zahlbr.

Inverness Co.: Margaree, on moss on rocks, coll. J. Macoun, July, 1898 (Macoun, 1902, p. 149, *s.n. Biatora hypnophila*). Fert.

Also cited by Macoun, loc. cit., from Baddeck, but the above specimen is the only one from Cape Breton now present in the National Herbarium.

Bacidia Schweinitzii (Tuck.) Schneid.

Victoria Co.: Baddeck, on trees, coll. J. Macoun, July 9, 1898, fert., mixed with *Mycoblastus sanguinarius*, the whole recorded by Macoun, 1902, p. 153, as *Heterothecium sanguinarium*.

Müller Arg. in Flora, LXI (1878), p. 482, showed that this species is identical with *Patellaria granulosa* Michx., Fl. Bor. Amer. II (1803), p. 320, according to his revision of the type-specimen from herb. Michaux. He states that the thallus contains "gonimia" and when moistened has an odour of violets. The symbiotic algæ of this species are actually *Trentepohlia* (well seen in Macoun's specimen and other North American material examined, e.g. Merrill, Lich. Exs. No. 214, Thomson, Lich. Wisconsinens. Exs. No. 36), which explains the odour detected by Müller Arg. If the "gonidial" system of classification of Zahlbruckner is followed, this species should belong to a new genus, similar to *Lecanactis*, but with true paraphyses (not opegraphine paraphysoid interthecial filaments).

Vainio, in Dansk Bot. Ark. IV (1926), p. 20, transferred this species to the genus *Toninia*, as *T. granulosa* (Michx.) Vain., but his reasons for doing so are obscure, for the furfuraceous-granulose thallus is quite unlike that of *Toninia*.

The epithet *granulosa*, although the earliest, cannot be used in preference to *Schweinitzii*, on account of the homonym *Bacidia granulosa* Darb. (1912).

Rhizocarpon concentricum (Dav.) Beltr.

Victoria Co.: W. side of Great Bras d'Or, between Ross Ferry and New Campbellton, alt. *circ.* 235 m.s.m., on dry stones in a stream bed in mixed woods, coll. I.M.L., July 24, 1952. (No. 6940). Fert.

Thallus sordid grey or cream-coloured, in orbicular patches. Apothecia ± concentrically arranged. The stone gives no effervescence with HCl.

Rhizocarpon disporum (Naeg.) Müll. Arg.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of stones near the seashore, associated with *Lecidea albidocinerella*, common, coll. I.M.L., July 19, 1952 (Nos. 6900, 6904 pr. p.). Fert.—Mainadieu, on seashore cliff about 5 m. above the sea, forming a scanty association with *Caloplaca elegans*, coll. I.M.L., July 23, 1952 (No. 6919). Fert.

Rhizocarpon distinctum Th. Fr.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 35 to 65 m.s.m., on granitic and other rocks on exposed hillside, partly associated with *Lecanora* (*Aspicilia*) *cinerea*, *Lecanora intricata*, *Lecidea cyanea* and *Rhizocarpon geographicum*, coll. I.M.L., June 30, and July 1 and 5, 1952 (Nos. 6783, 6784 pr. p., 6785 pr. p., 6809, 6846). Fert.

Rhizocarpon eupetræum (Nyl.) Arn.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on metamorphic block of talus slope at foot of cliffs, coll. I.M.L., July 3, 1952 (No. 6828). Fert.

Victoria Co.: 5 miles from Neil's Harbour, on granite outcrop in barren, associated with *Rh. geographicum*, coll. J. S. Erskine, July 26, 1950 (No. 50 C 1508 pr. p.). Fert.

Thallus KHO + yellow then red. In Erskine's specimen the medulla is I + distinct blue, but in the writer's No. 6828 no blue iodine reaction could at first be obtained. Finally at the third attempt a very faint, almost imperceptible blue staining of some of the medullary hyphæ with I was seen. Therefore the iodine reaction seems to be fluctuating or inconstant in this species, as it is in *Rh. grande*. Hue, 1888, p. 48, mentions a specimen of *Rh. eupetræum* (as *Lecidea eupetræa*) from Miquelon Island with medulla I–.

Rhizocarpon geographicum (L.) DC.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 50 to 65 m.s.m., on exposed granitic rocks on mountainside, associated with *Lecanora* (*Aspicilia*) *cinerea*, *Lecidea cyanea* and *Rhizocarpon distinctum*, and common on metamorphic blocks of talus slope at foot of cliffs, coll. I.M.L., June 30, and July 3, 1952 (Nos. 6785 pr. p., 6832). Fert.—Upper Salmon River, on dry rock face, coll. J. S. Erskine, July 9, 1952 (No. 52 C 2005). Fert.

Victoria Co.: Cape North, Gray Glen, Burnt Mountain, on stones of scree, associated with *Lecidea cyanea* and *Lecanora intricata*, coll. J. S. Erskine, July 10, 1952 (No. 52 C 2074 pr. p.). Fert.—Five miles from Neil's Harbour, on granite outcrop in barren, associated with *Rh. eupetraeum*, coll. J. S. Erskine, July 26, 1950 (No. 50 C 1508 pr. p.). Fert.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of stones on site of the inner fortifications, common, coll. I.M.L., July 19, 1952 (No. 6895). Fert.

Erskine's specimen from the Upper Salmon River belongs to the f. *atrovirens* (L.) Mass., with tumid-verrucose areolæ dispersed on a conspicuous black hypothallus.

Nichols, 1918, p. 327, mentions the association of *Rh. geographicum* on the shingle of the upper beaches in the northeast part of the island, and this was also noticed by the present author in passing by car along the shore road between North Shore and Briton Cove, but not collected.

Rhizocarpon obscuratum (Ach.) Mass.

F. **lavatum** (Ach.) Stein

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on wet boulders in a stream, common, coll. I.M.L., June 15, 1952 (No. 6664). Fert.

F. **reductum** (Th. Fr.) Eitn.

Inverness Co.: Craigmore, alt. *circ.* 150 m.s.m., on a stone in hillside pasture, coll. I.M.L., June 16, 1952 (No. 6693). Fert.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on boulders in open pasture, partly associated with *Rh. plicatile*, coll. I.M.L., June 28, 1952 (Nos. 6763 pr. p., 6765). Fert.

Rhizocarpon plicatile (Leight.) A.L.Sm. (Syn. *Rh. rubescens* Th. Fr.)

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on large boulder at side of road in spruce-fir woods, associated with *Lecidea* (*Biatora*) *coarctata*, coll. I.M.L., June 19, 1952, (No. 6699). Fert.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on stones and boulders in ± open pasture, associated with *Rh. obscuratum* and *Lecidea cinereoatra*, coll. I.M.L., June 28, 1952 (Nos. 6763 pr. p., 6764 pr. p.). Fert.—Same locality, alt. 65 to 85 m.s.m., on stones and boulders on roadside bank, partly associated with *Lecidea erratica*, coll. I.M.L., June 22, 1952 (Nos. 6733, 6734 pr. p.). Fert.

Cape Breton Co.: E. side of St. Andrew Channel between Barachois and George River, alt. 5 to 30 m.s.m., on granitic boulders and schistose rocks by the roadside, coll. I.M.L., July 22, 1952 (Nos. 6914, 6915). Fert.

Degelius, 1940, p. 28, considers Eckfeldt's records of "*Buellia rubescens*" and "*Buellia coniopsoideum*" from Newfoundland-Labrador as doubtfully referable to this species, but in view of its abundance in Cape Breton they probably represent the true *Rh. plicatile.*

Rhizocarpon tetramerum (Vain.) Vain.

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on loose stones by the roadside, coll. I.M.L., June 19, 1952 (No. 6697). Fert.

New to Canada. I have not seen the original specimen of Vainio's *Rh. tetramerum*, but the present specimen agrees so well with the description in his Lichenogr. Fennic. II (1922), p. 316, that there can hardly be any doubt as to its identity. The only differences noticeable are that in the writer's specimen the convex areolæ of the thallus are smaller (0·1 to 0·2 mm. diam.) and the epithecium is dark brown without any greenish-olivaceous tinge. Thallus-areolæ grey-brown, KHO−, medulla I−. Apothecia minute, 0·15 to 0·25 mm. diam. Outer surface of exciple æruginose-blackish. Hypothecium dark brown to brown-blackish. Hymenium low, 60 to 80 μ. Spores persistently colourless and 3-septate, 8næ, often halonate, 14 to 19 x 6 to 7 μ.

Rh. tetramerum is related to *Rh. postumum* (Nyl.) Th. Fr. and *Rh. microsporum* Lynge, but differs from both in the persistently 3-septate spores without longitudinal septa and the lower hymenium (100 to 120 μ high in the two species mentioned).

STEREOCAULACEAE

Stereocaulon coralloides Fr.

Inverness Co.: Margaree, on boulders in woods, mixed with *St. paschale*, coll. J. Macoun, July 1898, the whole recorded as *St. paschale* by Macoun, 1902, p. 123. Fert.—Craigmore, alt. 50 to 235 m.s.m., on metamorphic rocks and boulders on open hillside, and at sides of roads through mixed woods, often associated with *St. pileatum* and sometimes with *St. tomentosum*, coll. I.M.L., June 12, 13, 16, and 19, 1952 (Nos. 6600, 6618, 6626, 6627, 6639, 6678, 6707, 6708). Nearly always fert.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 65 to 85 m.s.m., on sandstone rocks and exposed granitic boulders at side of trails or on open rocky slopes, coll. I.M.L., July 1 and 5, 1952 (Nos. 6801, 6803, 6834). Mostly fert.—Vicinity of Whycocomagh, alt. 85 to 165 m.s.m., on metamorphic boulders at sides of trails through spruce forest and mixed woods, and in open *Vaccinium-Cornus-Lycopodium*-heaths, coll. I.M.L., Aug. 21, 1952 (Nos. 7018, 7019, 7020, 7021). All fert.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 430 m.s.m., on granite rocks in clearing of spruce woods near summit of mountain, coll. I.M.L., Aug. 6, 1952 (No. 6991). Fert.

Cape Breton Co.: E. side of St. Andrew Channel between Barachois and George River, alt. *circ.* 30 m.s.m., on rock by roadside, coll. I.M.L., July 22, 1952 (No. 6910). Fert.

On the exposed rocky slopes of Cape Breton Highlands Park the species commonly occurs in a compactly pulvinate state, and its customary fertility may be reduced.

Var. **occidentale** H. Magn.

Inverness Co.: Craigmore, alt. *circ.* 35 m.s.m., on metamorphic block on open hillside, coll. I.M.L., June 12, 1952 (No. 6604). Ster.

Cape Breton Co.: Vicinity of North Sydney, alt. *circ.* 50 m.s.m., on sandstone rocks in open heathy pasture, associated with *St. paschale* subsp. *evolutoides*, coll. I.M.L., Aug. 31, 1952 (Nos. 7028, 7029). Sparingly fert.

This variety is new to Canada. It is almost indistinguishable in the field from *St. paschale* subsp. *evolutoides*, with which it often grows intermingled, and is separable from the latter with certainty only by the Paraphenylenediamine test (*coralloides* var. *occidentale* PD + orange-red, *paschale* subsp. *evolutoides* PD + sulphur-yellow).

Var. **spissum** (Nyl. emend.) M. Lamb, **n. comb.** (Syn. *St. spissum* Nyl. *apud* Hue in Revue de Botan. VI, 1887-88, p. 192/6, *emend.*)

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 65 m.s.m., on granitic boulders on exposed mountainside, coll. I.M.L., June 30, 1952 (No. 6774). Ster.

Forming flattened-pulvinate, isolated, strongly dorsiventral, firmly attached clumps, resembling *St. paschale* subsp. *evolutoides* in habitus. Phyllocladia distinctly coralloid, as in the typical species.

The type-material is Zwackh-Holzhausen, Lich. Exs. No. 997 ("*Stereocaulon pileatum* * *spissum* Nyl., n. subspecies"). In Nylander's herbarium there are two examples of this exsiccat; one of them (Herb. Nyl. No. 39877) is sterile, and according to the writer's examination seems to be *St. paschale* subsp. *evolutoides*, with the phyllocladia PD − or faintly yellow, while the other (Herb. Nyl. No. 39878) is fertile, with the phyllocladia PD + (slowly) orange to orange-red. As Nylander describes apothecia and spores in his published description, this fertile specimen may be regarded as the lectotype. It is a variety of *St. coralloides* with decumbent dorsiventral habitus similar to that of the var. *occidentale* H. Magn., from which it differs in the distinctly coralloid phyllocladia (in var. *occidentale* crenate- to digitate-squamulose but not distinctly coralloid). Previously known from Europe.

Stereocaulon paschale (L.) Hoffm.

Inverness Co.: Margaree, on boulders in woods, coll. J. Macoun, July 22, 1898, mixed with *St. coralloides*, the whole recorded by Macoun, 1902, p. 123, as *St. paschale*. Fert.—Craigmore, alt. *circ.* 235 m.s.m., on metamorphic rock with slight soil cover at side of road through spruce-fir woods, with *Polytrichum*, coll. I.M.L., June 16, 1952 (No. 6670).

Ster.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on granitic and metamorphic blocks of talus slope at foot of cliffs, coll. I.M.L., July 5, 1952 (No. 6839). Ster.—Near Cap Rouge, alt. *circ.* 85 m.s.m., on exposed granitic boulder on rocky slope, partly overgrown by *Parmelia saxatilis*, coll. I.M.L., July 1st, 1952 (No. 6798 pr. p.). Ster.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 430 m.s.m., on granite rock in clearing of mixed woods, coll. I.M.L., Aug. 6, 1952 (No. 6986). Fert.—6 to 7 miles up the Clyburn Valley from Ingonish, alt. 200 to 330 m.s.m., on thin soil over rocks or directly attached to rock faces, coll. I.M.L., Aug. 9, 1952 (Nos. 7000, 7005). The former fert.—Near summit of Franey Mountain, alt. *circ.* 430 m.s.m., on granite rocks in clearing of spruce woods, coll. I.M.L., Aug. 6, 1952 (No. 6990). Fert.—Cape North by Bay St. Lawrence, alt. *circ.* 235 m.s.m., over mossy detritus on rocks of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6976). Fert.

Also given from Victoria Co., Baddeck (a locality not mentioned for it in Macoun's Catalogue) in Macoun's Canad. Lich. No. 133, fert.; perhaps referable to the f. *colligatum* M. Lamb, but material not very good, somewhat uncertain.

F. **colligatum** M. Lamb (n. f.)

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on stones with light soil cover beside road through mixed woods, coll. I.M.L., June 16, 1952 (No. 6682). Ster.

Victoria Co.: Ingonish, Middle Head, alt. *circ.* 25 m.s.m., on mossy soil over granite rocks on exposed headland, coll. I.M.L., July 29, 1952 (No. 6946, *type-specimen*). Ster.

Terricola; pseudopodetia substrato arcte adfixa, pulvinos laxos formantia, inferne sat rigida et lignosa et pro magna parte in terram defossa. Phyllocladia ut in specie typica.

Description of the type-specimen: Pseudopodetia forming somewhat laxly pulvinate clumps with uneven surface (the pseudopodetia rising to different levels), upright or variously intricated, not decumbent, not noticeably dorsiventral, the parts emergent from the soil 1·0 to 2·5 cm. high, firmly attached to the earthy substratum, into which the ± ligneous pseudopodetia penetrate for some depth (up to 2 cm.); crowded, moderately to well branched in an irregular fashion, terete, 0·6 to 1·0 mm. thick, glabrous or thinly adpressed-tomentose, whitish or ochraceous-whitish, largely conspurcated with earthy particles. Phyllocladia most abundant in upper parts of pseudopodetia, ± evenly distributed all round or more scanty on one side, crowded, of the typical *paschale*-type, whitish-grey, digitate-squamulose, small (0·2 to 0·4 mm. diam.). Cephalodia not uncommon on sides of pseudopodetia, pulvinate-globulose, 0·4 to 1·0 (−2·0) mm. diam., pale (ochraceous-whitish), at first slightly, then strongly tuberculate-verruculose, containing *Nostoc*. (No apothecia present.) Reactions: phyllocladia KHO + yellow, PD + (slowly) greenish sulphur-yellow.

Subsp. **depreaultii** (Del. ex Nyl.) M. Lamb, **n. comb.** (Syn. *St. Depreaultii* Del. ex Nyl., Synops. Lich. I, 1860, p. 249).

Several specimens of the type-collection, made by Despréaux in Newfoundland, exist in various herbaria, and they are all obviously parts of the same specimen. The following description is made from the type in herbarium Nylander (No. 39814), which also bears in an earlier handwriting (that of Delise ?) the identification "*tortuosum* Delise".

Cæspitose, detached. Pseudopodetia about 3 cm. high, up to 1·3 mm. thick at base, where brownish; otherwise now pallid brownish, 0·5 to 1·0 mm. thick, terete or slightly flattened, decorticate, smooth or slightly cariose, not tomentose, well covered with simple, crowded, grain-like, whitish phyllocladia of small size (0·10 to 0·15 mm. diam.). The phyllocladia simple and verruculiform-granose, with little or no tendency to fuse together into squamules. Cephalodia numerous, blackish, crowded, simple or botryose-verruculose, up to 0·6 mm. diam., with *Stigonema*. Apothecia numerous, terminal, often several confluent, brown-blackish, 0·8 to 1·5 mm. diam., convex-pulvinate. Hymenium 60 to 70 μ high. No ripe spores seen; acc. to Nylander they are usually 3-septate, 30 to 36 x 3·5 μ, and in a syntype-specimen in herbarium Asahina, Tokyo, they are 2- to 3-septate, 28 to 30 x 3 μ. In other syntype material seen, the pseudopodetia are firmly attached at the base with well developed basal holdfasts. Phyllocladia KHO + yellow, PD −.

Th. Fries saw some of this material of Despréaux and considered it to be *St. paschale*; a specimen of it ex herbarium Fée (Rio de Janeiro) bears his annotation as that species. It differs markedly from typical *St. paschale* in the strong, naked, woody, firmly affixed pseudopodetia, almost like those of *St. botryosum*, but in the phyllocladia, cephalodia, and apothecia, agrees with *paschale*. Until it is found again in its type locality and studied in the field, it seems provisionally best placed as a subspecies of *St. paschale*.

Var. **cæspitosulum** (Nyl.) M. Lamb, **n. comb.** (Syn. *St. denudatum* var. *cæspitosulum* Nyl., Synops. Lich. I, 1860, p. 247, footnote).

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on granitic and metamorphic blocks of talus slope at foot of cliffs, coll. I.M.L., July 3, 1952 (Nos. 6811, 6819). Partly sparingly fert.

Based on the exsiccat Tuckerman, Lich. Amer. Septentr. Exs. No. 114 ("*Stereocaulon denudatum*"). It has nothing to do with that species, but seems best placed under subsp. *depreaultii* as a variety, differing from the latter in its smaller stature and the tendency of its phyllocladia to become partly larger, flattened, and crenulate-squamulose, somewhat resembling those of *St. evolutum* Graewe. Like the subspecies, it is attached to rock with distinct basal holdfasts. The Cape Breton material forms small, compact, pulvinate tufts, firmly attached to the rock, the pseudopodetia quite glabrous, rigid, ligneous, ± resembling those of a small *St. botryosum*. The numerous cephalodia are brown to dark brown, verruculose-tuberculate, containing *Stigonema*. Phyllocladia PD + (slowly) faint yellow.

I have seen material of this variety from several localities in the United States (New Hampshire, Massachusetts, New York State, and Minnesota).

Subsp. **evolutoides** (H. Magn.) M. Lamb, **n. comb.** (Syn. *St. paschale* var. *evolutoides* H. Magn. in Göteborgs Kgl. Vetensk.- och Vitterhets-Samh. Handl., ser. 4, XXX, 1926, p. 50; *St. evolutoides* Frey in Rabh. Krypt.-Fl. IX, Abt. IV, 1. Hälfte, 1933, p. 145).

Inverness Co.: Craigmore, alt. 150 to 235 m.s.m., on rocks in hillside pasture and at side of road through mixed woods, coll. I.M.L., June 16, 1952 (Nos. 6685, 6689). The latter fert.—Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 85 m.s.m., on exposed granitic boulder on rocky slope, coll. I.M.L., July 1, 1952 (No. 6795). Fert.

Cape Breton Co.: Vicinity of North Sydney, alt. *circ.* 50 m.s.m., on sandstone rocks in open heathy pasture, intermixed with *St. coralloides* var. *occidentale* H. Magn., coll. I.M.L., Aug. 31, 1952 (No. 7029). Sparingly fert.

The specimens from Inverness County are of a lighter grey colour than is typical in this subspecies, approaching in this respect the typical *St. paschale.* The one from North Sydney is more aberrant, being firmly and widely attached to the rock, and with irregularly squamulose phyllocladia of a very variable shape, partly ± coalescent and sometimes inflated into almost globulose form, somewhat resembling galls.

St. paschale subsp. *evolutoides* often has quite a thick grey tomentum on the underside and is then difficult to distinguish from *St. tomentosum*; here the Paraphenylenediamine reaction is very useful, *St. paschale* subsp. *evolutoides* having the phyllocladia PD + sulphur-yellow, while those of *St. tomentosum* (at any rate in Eastern North America and Europe) are PD + orange-red. In Western North America and Eastern Asia a different strain of *St. tomentosum* occurs, with Lobaric instead of Stictic acid, and therefore PD + sulphur-yellowish; see M. Lamb, 1951, p. 553.

F. **laxatum** M. Lamb (n.f.)

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 85 m.s.m., on an exposed granitic boulder on rocky slope, coll. I.M.L., July 1, 1952 (No. 6802). Fert.

Est forma subspeciei evolutoidis *habitu magis laxo, pseudopodetiis discretis, decumbentibus, laxe reptantibus extensisque.*

The type-specimen is not the above but a specimen from Sweden, Värmland, Sillerud, Järnsjön, coll. A. H. Magnusson, 1912, in herbarium A. H. Magnusson. The following description is made from this type-specimen:

Pseudopodetia creeping over the substratum (probably detritus over rocks), radiating outwards, dorsiventral, long (up to 6 cm.), loosely entangled, irregularly branched, 0·5 to 1·0 mm. thick, ± loosely attached over a wide area on the underside, distinctly grey-tomentose, but the tomentum worn off in places. Phyllocladia concentrated on the upper side of the prostrate pseudopodetia, ash-grey, sessile, at first minutely granulate-squamulose as in *St. paschale* (typical), then becoming larger (up to 0·7 mm.) and crenate-squamulose; crowded or in some places ± dispersed. Corticate, squamulose phyllocladioid branchlets are also present (the corticated extremities of the finest pseudopodetial branches). Cephalodia not numerous, dark brown, pulvinate-subglobose, 0·8 to 1·5 mm. diam., distinctly tuberculate to finally almost botryose (not furfuraceous-scabrid as in typical *St. paschale*), containing *Stigonema.* Apothecia not abundant, terminal and also apparently lateral on the pseudopodetia (in the latter case in reality usually terminal on extremely short side-branches), small, 0·6 to 1·0 mm. diam., castaneous to brown-blackish, when young with a very thin, hardly prominent, paler brown margin, later becoming ± convex and immarginate. Hymenium about 50 μ high; spores 3-septate, 24 to 30 x 2·5 μ. Phyllocladia KHO + yellow, PD + (slowly) faint sulphur-yellowish.

Var. **grande** H. Magn.,

F. **velutinum** Frey

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on top of a large boulder by the roadside in spruce-fir woods, coll. I.M.L., June 19, 1952 (No. 6706). Fert.

Pseudopodetia smaller than typical in the var. *grande*, 3·0 to 4·5 (−5·0) cm. high, ± upright, loosely attached. Apothecia terminal, up to 2 (−2·5) mm. diam., convex, often dividing; tomentum heavy, pale grey, often aggregated into spongy pulvinuli.

F. **serpens** Th. Fr.

Inverness Co.: Vicinity of Whycocomagh, alt. *circ.* 85 m.s.m., on metamorphic boulder at side of trail through spruce forest, coll. I.M.L., Aug. 21, 1952 (No. 7022). Ster.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 300 m.s.m., on ± mossy surface of granite rock at side of trail through mixed woods, coll. I.M.L., Aug. 6, 1952 (No. 6993). Ster.—Seven to nine miles up the Clyburn Valley above Ingonish, alt. *circ.* 330 to 420 m.s.m., on rock faces in the stream gorge, coll. I.M.L., Aug. 9, 1952 (Nos. 7001, 7004). The latter fert.

Similar to the typical species, but noticeably decumbent and prostrate. Differs from subsp. *evolutoides* in the lighter whitish colour and the furfuraceous-scabrid dark cephalodia (with *Stigonema*).

Stereocaulon pileatum Ach.

Inverness Co.: Margaree, on rocks, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 124). Ster.—Craigmore, alt. 120 to 235 m.s.m., on boulders and rocks in open mixed woods, coll. I.M.L., June 13 and 19, 1952 (Nos. 6648, 6652, 6700, 6702). Mostly fert.

Victoria Co.: Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on conglomerate rock at side of road, coll. I.M.L., July 14, 1952 (No. 6866). Ster.

Also recorded by Macoun, 1902, p. 124, from Victoria Co., Baddeck, but the specimen is not present in the National Herbarium. The specimens seen are often very fine and well developed, with copious apothecia.

Stereocaulon tomentosum Fr.

Inverness Co.: Craigmore, alt. *circ.* 235 m.s.m., on rock at side of road through spruce-fir woods, associated with *St. coralloides*, coll. I.M.L., June 16, 1952 (No. 6678a). Fert.—Vicinity of Margaree Forks, alt. *circ.* 100 m.s.m., on large sandstone boulder with slight soil cover by the roadside, coll. I.M.L., June 22, 1952 (No. 6727). Fert.—Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 85 m.s.m., on exposed granitic boulder on rocky slope, coll. I.M.L., July 1, 1952 (No. 6798a). Ster.

Victoria Co.; Baddeck, on boulders in woods, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 124). Fert.; also given, probably from the same locality, in Macoun's Canad. Lich. No. 134.—About 4 miles up the Clyburn Valley above Ingonish, alt. *circ.* 50 m.s.m., among mosses and stones on river flats with sparse thickets and small trees of *Populus*, *Betula*, and *Alnus*, coll. I.M.L., Aug. 9, 1952 (No. 7008). Fert.

Cape Breton Co.: Louisburg, alt. *circ.* 5. m.s.m., on exposed heathy ground among stones on site of the fortifications, scarce, coll. I.M.L., July 19, 1952 (No. 6878). Ster.—East side of St. Andrew Channel between Barachois and George River, alt. *circ.* 30 m.s.m., on thin soil over rocks by the roadside, coll. I.M.L., July 22, 1952 (No. 6909). Fert.

CLADONIACEAE

Bæomyces roseus Pers.

Inverness Co.: Margaree, on earth, coll. J. Macoun, July 16 and 23, 1898 (Macoun, 1902, p. 140). Fert.; distributed by Macoun in Canad. Lich. No. 181.—Craigmore, alt. *circ.* 35 m.s.m., on bare soil of roadside cutting, plentiful, coll. I.M.L., June 12, 1952 (No. 6623). Fert.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on soil of roadside bank, abundant, coll. I.M.L., June 28, 1952 (No. 6767). Fert.—Vicinity of Whycocomagh, alt. *circ.* 85 m.s.m., on soil bank at side of road through mixed woods, covering extensive areas, coll. I.M.L., Aug. 21, 1952 (No. 7026). Fert.

Victoria Co.: Baddeck, on earth, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 140). Fert.—Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on soil bank at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6868). Fert.

Bæomyces rufus (Huds.) Rebent.

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on a metamorphic boulder in open mixed woods, coll. I.M.L., June 13, 1952 (No. 6649). Fert.

Victoria Co.: Baddeck, on earth, coll. J. Macoun, July 29, 1898 (Macoun, 1902, p. 140, *s.n. B. Byssoides*). Fert.—W. side of Great Bras d'Or, between Ross Ferry and New Campbellton, alt. *circ.* 235 m.s.m., on soil bank and on a stone in clearings of mixed woods, coll. I.M.L., July 24, 1952 (Nos. 6938, 6939). Fert.

The saxicolous specimens have small apothecia not over 1 mm. diam., and may be referred to the f. *rupestris* (Pers.) Harm.

Cladonia (Cladina) **alpestris** (L.) Rabh.

Inverness Co.: Margaree, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 135, *s.n. Cl. sylvatica* var. *alpestris*). Ster.—Cape Breton Highlands Park, near the Cheticamp entrance, alt. *circ.* 35 m.s.m., on mossy roadside bank at edge of spruce woods, coll. I.M.L., July 1, 1952 (No. 6789). Ster.—Near Cap Rouge, alt. *circ.* 85 m.s.m., among granitic boulders on exposed rocky slope, coll. I.M.L., July 1, 1952 (No. 6796). Ster.

Victoria Co.: Baddeck, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 135, *s.n. Cl. sylvatica* var. *alpestris*). Ster.—Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., between stones of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6975). Ster.—Mountains N. of Barrasois River, coll. G. E. Nichols, 1914 (Herb. Yale Univ., confirm. A. W. Evans).—Near mouth of Indian Brook, coll. G. E. Nichols, 1914 (Herb. Yale Univ., confirm. A. W. Evans).—New Campbellton, coll. D. White and C. Schuchert, 1897 (Herb. Yale Univ., confirm. A. W. Evans).

According to Nichols, 1918, p. 400, *Cl. alpestris* is one of the characteristic species of the upper barrens, and his photograph (Fig. 53, on p. 403) shows it growing in some profusion on the barrens W. of Ingonish.

Cladonia impexa Harm.

Subsp. **laxiuscula** (Del.) Sandst.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., between blocks of talus slope at foot of cliffs, coll. I.M.L., July 5, 1952 (No. 6837). Ster.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., in soft moist hummocks of *Sphagnum*, *Vaccinium*, and *Drosera* on open heathy ground, coll. I.M.L., July 19, 1952 (No. 6892). Ster.

Concerning this species, A. W. Evans writes in litt., 26. ii. 1953: "I have seen comparatively little material of C. impexa from North America. Aside from Nova Scotia our herbarium has specimens from Massachusetts and New Jersey in eastern North America and from Alaska and Washington in western. Of course, it is easily overlooked or confused with other Cladinæ, but I have searched for it carefully in Connecticut without success."

Cladonia mitis Sandst.

Inverness Co.: Margaree, on earth in woods, coll. J. Macoun, July 1898 (Macoun, 1902, p. 134, *s.n. Cl. sylvatica*). Ster.—Craigmore, alt. 50 to 135 m.s.m., in hillside pasture between rocks, common, coll. I.M.L., June 12 and 16, 1952 (Nos. 6602, 6683). Ster.—Vicinity of Margaree Forks, alt. *circ.* 85 m.s.m., on roadside bank, in scattered patches, coll. I.M.L., June 22, 1952 (No. 6726). Ster.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., between rocks at foot of talus slope, coll. I.M.L., July 3, 1952 (No. 6813). Ster.

Victoria Co.: Baddeck, on earth, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 134, *s.n. Cl. rangiferina*). Ster.—Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., between stones of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6973). Ster.—Near Twin Island Lake, Ingonish Barrens, coll. J. S. Erskine, 1952 (No. 52 C 1938).

Ster.—Barrens W. of Ingonish, coll. G. E. Nichols, 1916, 1917 (Herb. Yale Univ., det. A. W. Evans).—Near Indian Brook, coll. G. E. Nichols, 1909, 1914 (Herb. Yale Univ., det. A. W. Evans).—Mountains North of Barrasois River, coll. G. E. Nichols, 1914 (Herb. Yale Univ., det. A. W. Evans).

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on exposed heathy ground among stones on site of the fortifications, coll. I.M.L., July 19, 1952 (No. 6877). Ster.—East side of St. Andrew Channel between Barachois and George River, alt. *circ.* 30 m.s.m., on soil bank by roadside, coll. I.M.L., July 22, 1952 (No. 6908). Ster.

Cladonia rangiferina (L.) Web.

Inverness Co.: Margaree, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 134). Ster.—Craigmore, alt. 85 to 150 m.s.m., in rocky hillside pasture, common, coll. I.M L. June 12 and 16, 1952 (Nos. 6615, 6687). Ster.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on humus over boulder in rocky pasture, coll. I.M.L., June 28, 1952 (No. 6768). Ster.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 50 to 85 m.s.m., among granitic boulders on rocky slope, and between rocks of talus slope, coll. I.M.L., July 1 and 3, 1952 (Nos. 6794, 6812). Ster.

Victoria Co.: Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., between stones of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6974). Ster.—Mary Ann Brook Fire Trail, in woods, associated with *Cl. gracilis* var. *elongata*, coll. J. S. Erskine, 1950 (No. 50 C 1542 pr. p.). Ster.—Valley of Barrasois River, coll. G. E. Nichols, 1914 (Herb. Yale Univ., det. A. W. Evans).—Mountains W. of Ingonish, in dry barrens, coll. G. E. Nichols, 1917 (Herb. Yale Univ., confirm. A. W. Evans).—Near Indian Brook, coll. G. E. Nichols, 1909 (Herb. Yale Univ., confirm. A. W. Evans).—Near mouth of Indian Brook, in spruce woods near beach, coll. G. E. Nichols, 1914 (Herb. Yale Univ., confirm. A. W. Evans).

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on exposed heathy ground among stones on site of the fortifications, coll. I.M.L., July 19, 1952 (No. 6882). Ster.—E. side of St. Andrew Channel between Barachois and George River, alt. *circ.* 30 m.s.m., on soil bank at edge of spruce woods by roadside, coll. I.M.L., July 22, 1952 (No. 6907). Ster.

The writer's No. 6687 from Craigmore is the f. *umbellata* Anders.

Cladonia (Pycnothelia) **papillaria** (Ehrh.) Hoffm.

Victoria Co.: Cape North, Gray Glen, on bare slope of Burnt Mountain, coll. J. S. Erskine, 1952 (No. 52 C 2020). Ster.

Belongs to the f. *papillosa* Fr.

Cladonia (Cenomyce) **Boryi** Tuck.

Inverness Co.: MacGregor Mountain above Cabot Trail, on barren, coll. J. S. Erskine, 1950 (No. 50 C 1560). Ster.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on exposed heathy ground and between stones on the site of the fortifications, coll. I.M.L., July 19, 1952 (Nos. 6879, 6883, 6890). Ster.

All specimens belong to the f. *lacunosa* (Bory) Tuck.

Dr. A. W. Evans kindly communicated the following information concerning *Cl. Boryi* in litt., 26. ii. 1953: "The range of C. Boryi in eastern North America, according to the specimens in our herbarium, extends from Quebec and Nova Scotia southwards to New Jersey. In parts of its range, such as the Cape Cod region and eastern Long Island, it is abundant and its colonies may cover extensive areas. Away from the coast, however, it usually occurs sparingly. Sandstede, in the Pflanzenareale, gave the species a range extending far beyond eastern North America, but the specimens I have seen from South America, New Zealand, and elsewhere are not like our eastern North American plant and deserve further study."

Cladonia caespiticia (Pers.) Flk.

Inverness Co.: Margaree, on boulders, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 132). Fert.

Cladonia cenotea (Ach.) Schaer.

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on a rotten stump in open mixed woods, coll. I.M.L., June 13, 1952 (No. 6628). Ster.

Victoria Co.: Baddeck, on earth in woods, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 131). Ster.

The typical form of the species (= var. *crossota* (Ach.) Nyl.).

Cladonia chlorophæa (Flk.) Spreng.

Inverness Co.: Craigmore, alt. *circ.* 50 m.s.m., on open hillside, coll. I.M.L., June 12, 1952 (No. 6606). Ster.—Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 65 m.s.m., on detritus in crevice between boulders on exposed mountainside, coll. I.M.L., June 30, 1952 (No. 6773). Ster.

Victoria Co.: Baddeck, on old stumps, coll. J. Macoun, July 1898 (Macoun, 1902, p. 127, *s.n. Cl. pyxidata*). Partly fert.—Ingonish, coll. Mrs. Romney Smith, 1940 (Herb. Yale Univ., det. A. W. Evans).

The writer's specimens from Inverness Co. belong to the f. *simplex* (Ach.) Harm.; Macoun's from Baddeck is partly the f. *carpophora* Anders.; while that from Ingonish collected by Mrs. Romney Smith is "hardly referable to any definite form" (A. W. Evans in litt.). Macoun, loc. cit., lists another specimen of "*Cladonia pyxidata*" from Margaree, but it could not be found in the National Herbarium.

Cladonia coniocræa (Flk.) Vain.

Victoria Co.: Baddeck, on rotten wood, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 128, *s.n. Cl. fimbriata* var. *tubæformis*). Ster.

Belongs to the f. *ceratodes* Flk. The other specimen of "*Cl. fimbriata* var. *tubæformis*" listed by Macoun, loc. cit., from Margaree is not now present in the National Herbarium.

Cladonia cornuta (L.) Schaer.

Victoria Co.: Smoky Mountain, on earth, coll. J. Macoun, Aug. 2, 1898 (Macoun, 1902, p. 130). Ster.

The typical form of the species (= f. *cylindrica* (Schaer.) Vain.).

Cladonia crispata (Ach.) Flot.

Var. **dilacerata** (Schaer.) Malbr.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 430 m.s.m., on granite rock in clearing of spruce woods, among mosses and *Stereocaulon paschale*, coll. I.M.L., Aug. 6, 1952 (No. 6989). Fert.

Var. **virgata** (Ach.) Vain.

Victoria Co.: Englishtown, on earth, coll. J. Macoun, Aug. 2, 1898 (Macoun, 1902, p. 133, *s.n. Cl. furcata* var. *crispata*). Ster.—Dry barrens North of Ingonish, coll. G. E. Nichols, 1914 (Herb. Yale Univ., confirm. A. W. Evans).

Cladonia cristatella Tuck.

Inverness Co.: Craigmore, alt. *circ.* 50 m.s.m., on decaying beams of a ruined house on open hillside, coll. I.M.L., June 12, 1952 (No. 6616). Fert.—Craigmore, alt. 135 to 150 m.s.m., on mossy ground in sparsely wooded pasture and in open mixed woodland, coll. I.M.L., June 13 and 16, 1952 (Nos. 6636, 6688). Fert.

Victoria Co.: Baddeck, on old logs and stumps, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 139). Fert.—Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on humous ground among rotting tree stumps in a clearing of the woods, coll. I.M.L., July 14, 1952

(No. 6865). Fert.—Near Sunset Cape North, alt. *circ.* 100 m.s.m., on mossy soil in a previously burnt-over spruce stand, coll. I.M.L., July 31, 1952 (No. 6957). Ster., but with numerous red pycnidia.—Mountains north of Barrasois River, in dry barrens, coll. G. E. Nichols, 1914 (Herb. Yale Univ., det. L. W. Riddle, confirm. A. W. Evans).

All specimens belong to the f. *Beauvoisii* (Del.) Vain.

The specimen mentioned by Macoun, 1902, p. 139, from Margaree is missing in the National Herbarium.

Cladonia digitata Schaer.

Inverness Co.: Margaree, on logs in woods, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 138, *s.n. Cl. deformis*). With apoth. initials.

The f. *monstrosa* Ach.

Cladonia fimbriata (L.) Fr.

Inverness Co.: Margaree, on old logs and stumps, coll. J. Macoun, July 16, 1898, intermixed with *Cl. Grayi*, the whole recorded as *Cl. fimbriata* in Macoun, 1902, p. 128. Ster.

Also recorded by Macoun, loc. cit., from Victoria Co., Baddeck, but no corresponding specimen is now present in the National Herbarium.

Cladonia furcata (Huds.) Schrad.

Var. **racemosa** (Hoffm.) Flk.

Inverness Co.: Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on the ground among mosses and limestone rocks in open mixed woods, coll. I.M.L., June 22, 1952 (No. 6721). Ster.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 50 to 85 m.s.m., between rocks and boulders on open rocky slopes, or over rocks and detritus in open woods, coll. I.M.L., July 1, 3, and 5, 1952 (Nos. 6797, 6822, 6838). Ster.

Victoria Co.: Aspy Trail, on soil under woods, coll. J. S. Erskine, 1950 (No. 50 C 1526). Ster.

Cape Breton Co.: Sydney, coll. J. Macoun, 1883 (not recorded from there in Macoun's Catalogue, but distributed in his Canad. Lich. No. 53; the record is uncertain, however, for a locality in British Columbia is also mentioned on the same label.).

The writer's No. 6822 from Cape Breton Highlands Park belongs to the f. *squamulifera* Sandst.

Cladonia gracilis (L.) Willd.

Var. **chordalis** (Flk.) Schaer.

Inverness Co.: Margaree, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 130, *s.n. Cl. gracilis* var. *elongata*). Ster.

Victoria Co., Baddeck, on earth in cool woods, coll. J. Macoun, July 12, 1898 (not recorded in Macoun's Catalogue, but distributed by him in Canad. Lich. No. 145, *s.n. Cl. gracilis* var. *chordalis*). Fert.

Cape Breton Co., Louisburg, alt. *circ.* 5 m.s.m., on exposed heathy ground among stones on site of the fortifications, coll. I.M.L., July 19, 1952 (No. 6880). Ster.

Macoun's specimen from Baddeck distributed in Canad. Lich. No. 145 has the podetia larger than is usual in this variety, 5 to 9 cm. tall.

Var. **dilatata** (Hoffm.) Vain.

Inverness Co.: Craigmore, alt. *circ.* 150 m.s.m., between rocks in mossy hillside pasture, coll. I.M.L., June 16, 1952 (No. 6690). Fert.

Macoun's records of "*Cl. gracilis* var. *hybrida*" from Margaree and Baddeck in his Catalogue, p. 130, probably refer here, but neither of the specimens could be found in the National Herbarium.

Var. **elongata** (Jacq.) Flk.

Inverness Co.: Cape Breton Highlands Park, near the Cheticamp entrance, alt. *circ.* 35 m.s.m., on mossy roadside bank at edge of spruce woods, coll. I.M.L., July 1, 1952 (No. 6790). Ster.

Victoria Co.: Baddeck, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 130). Ster.—Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., between boulders of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6979). Fert.—Mary Ann Brook Fire Trail, in woods, associated with *Cl. rangiferina*, coll. J. S. Erskine, 1950 (No. 50 C 1542 pr. p.). Ster.

Cladonia Grayi Merrill

Inverness Co.: Margaree, on old logs and stumps, coll. J. Macoun, July 16, 1898, intermixed with *Cl. fimbriata*, the whole recorded by Macoun, 1902, p. 128, as *Cl. fimbriata*. Fert.

Victoria Co.: Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., at base of a decaying stump in a clearing of the woods, coll. I.M.L., July 14, 1952 (No. 6863). Fert.—Ingonish, coll. Mrs. Romney Smith, 1940 (Herb. Yale Univ., det. A. W. Evans).

The writer's No. 6863 from Hunter's Mountain is the f. *carpophora* Evans; the others are f. *cyathiformis* Sandst.

Cladonia multiformis Merrill

Victoria Co.: Baddeck, on earth, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 133, *s.n. Cl. furcata* var. *crispata*). Fert.; two specimens (see below).—West side of Great Bras d'Or between Ross Ferry and New Campbellton, alt. *circ.* 235 m.s.m., on a mossy rock in a wooded stream-gully, coll. I.M.L., July 24, 1952 (No. 6935). With apoth. initials.

The writer's specimen from the Great Bras d'Or represents the f. *simulata* Robbins; of the two specimens from Baddeck collected by Macoun, one is referable to the f. *Finkii* (Vain.) Evans and the other to the f. *subascypha* (Vain.) Evans.

Cladonia pleurota (Flk.) Schaer.

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 85 m.s.m., on detritus over an exposed granitic boulder, coll. I.M.L., July 1, 1952 (No. 6799). Ster.

Victoria Co.: Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on soil bank at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6856). Ster.—Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., on detritus over boulders of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6972). With apoth. initials.—Mary Ann Brook Fire Trail, on barren soil, associated with *Cornicularia aculeata*, coll. J. S. Erskine, 1950 (No. 50 C 1540 pr. p.). With apoth. initials.—Mountains N. of Barrasois River, in dry barrens, coll. G. E. Nichols, 1914 (Nichols, 1918, p. 400, *s.n. Cl. coccifera*; Herb. Yale Univ., revid. A. W. Evans).

Erskine's specimen from Mary Ann Brook Fire Trail is the f. *frondescens* Nyl.

[*Cladonia pyxidata* (L.) Fr.

This species is mentioned by Nichols, 1918, p. 400, as one of the characteristic species of the upper barrens, but there is no specimen in the Yale Univ. Herb., where the other *Cladoniæ* collected by Nichols are preserved. Possibly the record refers to *Cl. chlorophæa*.]

[*Cladonia rangiformis* Hoffm.

The var. *pungens* (Ach.) Vain. of this species is recorded by Macoun, 1902, p. 134, as *Cl. furcata* var. *pungens*, from Inverness Co., Margaree, but the specimen referred to is missing in the National Herbarium.]

Cladonia scabriuscula (Del.) Sandst.

Victoria Co.: Baddeck, on earth, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 133, *s.n. Cl. furcata* var. *racemosa*). Partly fert.

The typical form of the species (= f. *surrecta* Flk.).

Cladonia squamosa (Scop.) Hoffm.

Inverness Co.: Craigmore, alt. *circ.* 200 m.s.m., on mossy trunk of *Fagus* beside trail through mixed woods, coll. I. M.L., June 16, 1952 (No. 6671). Fert.—Margaree, on rocks, coll. J. Macoun, July 14, 1898 (Macoun, 1902, p. 132). Ster.

F. **denticollis** (Hoffm.) Vain.

Inverness Co.: Craigmore, alt. *circ.* 100 m.s.m., on a rotten mossy stump in open mixed woods, coll. I.M.L., June 13, 1952 (No. 6640). Ster.

F. **levicorticata** Sandst.

Inverness Co.: Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on humus over a boulder in rocky pasture, coll. I.M.L., June 28, 1952 (No. 6769). Fert.

Cape Breton Co.: East side of St. Andrew Channel between Barachois and George River, alt. *circ.* 30 m.s.m., growing in small brownish tufts on bare soil among roots of spruce trees at the roadside, coll. I.M.L., July 22, 1952 (No. 6911). Ster.

Both specimens are in the m. *rigida* (Del.) Evans.

F. **phyllocoma** (Rabh.) Vain.

Inverness Co.: Craigmore, alt. 135 to 200 m.s.m., on mossy ground in mixed woods, coll. I.M.L., June 13 and 16, 1952 (Nos. 6629, 6677). Ster.

Cladonia turgida (Ehrh.) Hoffm.

Inverness Co.: Margaree, on rocks, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 131). Ster.—Craigmore, alt. *circ.* 50 m.s.m., on open rocky hillside, coll. I.M.L., June 12, 1952 (No. 6603). Ster.—South Blair River, on soil in thin woods, coll. J. S. Erskine, 1950 (No. 50 C 1597). Ster.

Victoria Co.: Cape North, Gray Glen, on bare slope of Burnt Mountain, coll. J. S. Erskine, 1952 (No. 52 C 2021). Ster.

Erskine's specimens are the species in its typical form, Macoun's from Margaree belong to the f. *squamulosa* (Rabh.) Theobald, and the writer's from Craigmore represent the f. *scyphifera* Vain.

Cladonia uncialis (L.) Web.

Inverness Co.: Craigmore, alt. *circ.* 120 m.s.m., on the ground at side of trail in spruce-fir woods, coll. I.M.L., June 19, 1952 (No. 6709). Ster.

Victoria Co.: Francy Mountain trail near Ingonish, alt. *circ.* 300 m.s.m., on mossy granite rock in mainly deciduous woods, coll. I.M.L., Aug. 6, 1952 (No. 6992). Ster.—Dry barrens west of Ingonish, coll. G. E. Nichols, 1917 (Herb. Yale Univ., confirm. A. W. Evans).

Cape Breton Co.: Louisburg, alt. *circ.* 5. m.s.m., in crevices between stones on site of the fortifications, coll. I.M.L., July 19, 1952 (Nos. 6884, 6886). Ster.

Cl. uncialis (var. *adunca*) is recorded by Macoun, 1902, p. 136, from Baddeck and Half Way Brook, but no specimens of it from these localities are now present in the National Herbarium.

Cladonia verticillata Hoffm.

Inverness Co.: Vicinity of Margaree Forks, alt. *circ.* 50 m.s.m., on top of a large conglomerate boulder by the roadside, open position, coll. I.M.L., June 22, 1952 (No. 6714) Fert.

Victoria Co.: Baddeck, on earth, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 129, *s.n. Cl. gracilis* var. *verticillata*). Fert.

The f. *evoluta* (Th. Fr.) Stein, or, in the case of Macoun's specimen, partly the f. *aggregata* (Del.) Malbr. Macoun, 1902, p. 129, also records "*Cl. gracilis* var. *verticillata*" from Inverness Co., Margaree, but no corresponding specimen is present in the National Herbarium.

GYROPHORACEAE

Umbilicaria (Gyrophora) **deusta** (L.) Baumg.

Inverness Co.: Half Way Brook, on rocks, coll. J. Macoun, Aug. 6, 1898 (Macoun, 1902, p. 80, *s.n. U. flocculosa*). Ster.

Victoria Co.: Ingonish, Middle Head, alt. *circ.* 25 m.s.m., on large granite boulders in clearing of spruce woods, coll. I.M.L., July 29, 1952 (Nos. 6941, 6947). Ster.

[*Umbilicaria hyperborea* (Ach.) Hoffm.

I did not find this species, nor did Macoun, but Nichols, 1918, p. 327, mentions it as occurring on the shingle of the upper beach in the northeast parts of the island.]

Umbilicaria Mühlenbergii (Ach.) Tuck.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 60 m.s.m., on exposed granitic blocks on mountainside, and on blocks of talus slope at foot of cliffs, coll. I.M.L., June 30, and July 5, 1952 (Nos. 6777, 6836). Fert.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 200 m.s.m., on large granite rock on lightly wooded mountainside, abundant, coll. I.M.L., Aug. 6, 1952 (No. 6988). Fert.

Umbilicaria vellea (L.) Ach.

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 65 m.s.m., on exposed granitic rock face, scarce, coll. I.M.L., June 30, 1952 (No. 6776). Ster.

Victoria Co.: near Sunset Cape North, alt. *circ.* 165 m.s.m., on exposed granite rock face on mountainside, fairly abundant, coll. I.M.L., July 31, 1952 (No. 6953). Fert.

Umbilicaria (Lasallia) **papulosa** (Ach.) Nyl.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 50 to 85 m.s.m., on exposed granitic boulders, on blocks of talus slope at foot of cliffs, and on metamorphic rock in a wooded stream-gully, coll. I.M.L., July 1 and 3, 1952 (Nos. 6800, 6814, 6824). Fert. or with apoth. initials.

Number 6824 has the medulla partly reddish, and in many of the foveolæ of the underside are cinnabarine-red spots. Some of the apothecia are also slightly reddish-suffused. This tendency towards production of erythrinose pigment varies considerably in the *U. papulosa*-group, as has been pointed out by Frey (1949, p. 438). In the S. African var. *rubiginosa* (Pers.) Frey, the whole upper side of the thallus is red, and in "*Umbilicaria labradorense*" Hult. *apud* Eckf., which has been rightly reduced to a synonym of *U. papulosa* by Llano (1950, p. 33), the sanguineous-red coloration is, as in our specimen, confined to the foveolæ of the underside (Hulting *apud* Eckfeldt, 1895, p. 245), or present only in the medulla (Hulting, 1896, p. 193).

ACAROSPORACEAE

Acarospora amphibola Wedd.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on a loose gneissic stone lying at the back of the rocky seashore, coll. I.M.L., July 19, 1952 (No. 6898). Fert.

New to Canada.

A meagre state of the species with small, very dark (almost blackish), isolated or grouped squamules 0·4 to 0·8 (−1·2) mm. diam., often following the crevices of the stone. Thalline cortex brown, $CaCl_2O_2-$, 24 to 34μ thick, covered by a colourless, ± structureless, necrotic stratum 10 to 22 μ thick. Squamules ± pale on underside, no dark hypothalline tissue developed. Hymenium 110 to 125 μ high, yellow-brown to dark brown above; paraphyses 1·0 to 1·5 μ thick. Spores very numerous in ascus, ellipsoid to oblong-ellipsoid, 3·0 to 3·5 x 1·5 μ, often with two lighter-coloured or refractive spots (oil-droplets?) at the ends, and hence of almost polaribilocular appearance under oil-immersion objective.

In Europe this is an Atlantic-West Baltic coastal species, confined, as here, to a narrow zone along the shore (Swed. "stormbältet"); see Magnusson, 1929, p. 137, with distributional map 2 on p. 391.

Acarospora fuscata (Schrad.?) Arn.

Cape Breton Co.: vicinity of North Sydney, alt. *circ.* 85 m.s.m., on sandstone rocks in open heathy pasture, coll. I.M.L., Aug. 19, 1952 (No. 7015). Fert.

PERTUSARIACEAE

Pertusaria (Ampliaria) **alpina** Hepp
Var. **occulta** Erichs.

Inverness Co.: Margaree, on bark of trees, coll. J. Macoun, July 20, 1898 (Macoun, 1902, p. 120, *s.n. P. leioplaca*). Fert.

Pertusaria (Eupertusaria) **neoscotica** M. Lamb (n. sp.) Plate II.

Victoria Co.: Baddeck, on tree trunk, coll. J. Macoun, July 9, 1898 (No. 1953 pr. p.). associated with *Melanaria macounii* var. *meizotoca*, the whole recorded in Macoun's Catalogue, 1902, p. 120, as *P. communis*. Fert.

Thallus cinerascens aut subochraceo-cinerascens, tenuis aut crassitudine mediocri (ad 0·2 – 0·3 mm.), sat late effusus, passim linea hypothallina nigricanti limitatus, rimosus vel partim fere areolatus, inaequalis, sorediis isidiisque destitutus. Verrucæ fertiles numerosæ, sparsæ, subglobosæ vel deplanato-subsphæricæ, 0·8 – 2·0 mm. latæ, basi modice aut demum perbene constrictæ, thallo concolores vel sæpe nonnihil magis subochraceo-tinctæ, polycarpicæ (ostiolis 5 – 20). Ostiola punctiformia, nigricantia, 0·05 – 0·10 mm. lata, leviter prominentia et vulgo annulo albido satis distincto ad 0·2 mm. lato circumdata. Paraphyses solitæ generis, 1·0 – 1·5 μ crassæ. Asci clavati, 200 – 240 x 35 – 50 μ, bispori. Sporæ uniseriatæ, incolores, (60–) 85 – 130 x *(27–) 30 – 45 μ, pariete 7 – 9 μ crasso, transversim striato sed haud grosse costulato. Thallus (et verrucæ fertiles) KHO + lutescens deinque sanguineo-rubescens, $CaCl_2O_2-$, PD (saltem in medulla) + persistenter lutescens. Hyphæ medullares I–. —Affinis ut videtur* P. subobductanti *Nyl. (e Japonia), at thallo rimoso, verrucis fertilibus majoribus, aliisque notis satis diversa. Corticola.*

Thallus forming a patch 5 x 2·5 cm. on smooth bark, subdeterminate and in places bounded by a thin black line (perhaps only at junction with other lichens), thin or of moderate thickness (up to 0·2 to 0·3 mm.), ash-grey or cream-coloured, in places with a very faint subochraceous tinge, matt, reticulate-rimose or indistinctly areolate, uneven or subverrucose, without isidia or soredia, KHO + yellow then slowly red, $CaCl_2O_2$ −, PD (at any rate in the medulla) + persistent yellow. Medullary hyphæ I−.

Fertile verrucæ numerous, scattered, subglobose or flattened-subglobose, 0·8 to 2·0 mm. diam., at first moderately, then becoming strongly constricted at base, concolorous with the thallus or often with a more distinct subochraceous tinge, not farinose, each with numerous (5 to 20) punctiform, blackish, slightly prominent ostioles 0·05 to 0·10 mm. diam., each ostiole usually surrounded by a ± distinct whitish annulus up to 0·2 mm. diam. Reactions same as those of thallus, but the KHO reaction stronger, yellow then soon intense blood-red. Paraphyses branched and connected, 1·0 to 1·5 μ thick. Asci clavate, 200 to 240 x 35 to 50 μ, the immature asci with thick wall (10 to 12 μ). Spores two in ascus, uniseriate, colourless, (60−) 85 to 130 x (27−) 30 to 45 μ; spore-wall 7 to 9 μ thick, not thicker at ends, transversely finely furrowed or striated but not grossly costulate.

The shape of the fertile verrucæ, with their numerous small ostioles, somewhat recalls to mind the stromata of *Trypethelium eluteriæ* Spreng.

P. neoscotica belongs to the subgen. *Eupertusaria* Erichs. and the sect. *Rubescentes* Erichs. (1935, p. 341).

Pertusaria rubefacta Erichs.

Victoria Co.: Baddeck, on trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 120, *s.n. P. leioplaca*). Fert.

A very distinct species, described from Canada, New Brunswick, Dalhousie, by Erichsen in Fedde, Repert. XXXV (1934), pp. 387 195, on material collected by T. Reijonen which had previously been determined as "*P. xanthostoma*" by Räsänen in Ann. Mo. Bot. Gard. XX (1933), p. 14. It is characterized by the ± yellowish thallus, the monocarpic, unevenly tumid-crenulate fertile verrucæ with sunken, dilated, black ostioles, the 8-spored asci, and by the KHO + red reaction (with formation of crystals) manifested only in the fruit-bodies, the thallus being KHO + yellow only. The PD reaction is negative in the thallus, orange in the apothecial verrucæ. In outward appearance it rather resembles *P. Wulfenii* DC.

Macoun's specimen agrees excellently with Erichsen's description, loc cit., except in the somewhat smaller asci (250 to 300 x 40 to 55 μ). The spores are biseriate in the ascus, 80 to 95 x 30 to 40 μ, with smooth wall 5 to 10 μ thick, at the ends often thickened up to 13 μ. The olivaceous-fuliginous epithecium becomes sordid violet in KHO.

Pertusaria (Variolaria) **amara** (Ach.) Nyl.

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on trunk of *Fagus* in mixed woods, coll. I.M.L., June 15, 1952 (No. 6661). Fert.—Vicinity of Margaree Forks, alt. *circ* 65 m.s.m., on trunks of *Abies* in more open parts of spruce-fir woods, forming orbicular patches, coll. I.M.L., June 23, 1952 (No. 6749). Ster.—Same locality, alt. *circ.* 35 m.s.m., on sloping limestone rocks at the bank of the river, somewhat shaded by trees, coll. I.M.L., June 22, 1952 (No. 6737). Ster.

Victoria Co.: Baddeck, on trees, coll. J. Macoun, July 8, 1898, mixed with another *Pertusaria*-species (badly developed, not determinable), the whole recorded by Macoun, 1902, p. 119, as *P. multipuncta*. Ster.

The other specimen mentioned under *P. multipuncta* by Macoun, loc. cit., from Margaree, is not present in the National Herbarium.

The soredia in all specimens give the characteristic fugaceous purple-violet K(C) reaction, PD −. In the fruiting specimen from Craigmore the structure of the fruit-bodies, with their monosporous asci, agrees with the description given by Erichsen, 1935, p. 562. The occurrence of No. 6737 on limestone rock shows the lack of specialization of this species with regard to substratum, although by far its most usual occurrence is on trees.

Pertusaria (Lecanorastrum) **velata** (Turn.) Nyl.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on trunk of *Acer* in open woods alongside a stream-gully, coll. I.M.L., July 3, 1952 (No. 6823). Fert.

Victoria Co.: Baddeck, on trees in woods, coll. J. Macoun, July 9, 1898, associated with *P. amara*, another indeterminable morbose *Pertusaria*-species, *Ochrolechia androgyna* and *Lecidea helvola*, the whole recorded by Macoun, 1902, p. 119, as *P. velata*. Fert.—Near Sunset Cape North, alt. *circ.* 65 m.s.m., on trunk of *Quercus* in light mixed woods, coll. I.M.L., July 31, 1952 (No. 6963). Fert.

The specimen from Margaree mentioned by Macoun, 1902, p. 119, could not be found in the National Herbarium.

My No. 6823 from Cape Breton Highlands Park belongs to the f. *cinerascens* Erichs., with dark ash-grey thallus.

Melanaria macounii M. Lamb (n. sp.) Plate III, upper figure.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 165 m.s.m., on trunk of *Fagus* beside trail through mixed woods, associated with a sterile, white, crustaceous lichen, coll. I.M.L., Aug. 6, 1952 (No. 6985, holotype of the species). Fert.

Thallus flavo-glaucescens aut glauco-stramineus, tenuis aut modice incrassatus, continuus aut demum rimosus, effusus, indeterminatus (tantum conjunctu cum aliis lichenibus anguste nigro-determinatus). Verrucæ fertiles sparsæ, 0·7 − 1·0 mm. latæ, subglobosæ, thallo concolores, basi sat bene constrictæ, interdum aggregatæ vel 2 − 3 confluentes et tunc ad 2 (−2·5) mm. latæ et ambitu magis irregulares; 1 − 3-ostiolatæ (ad 12-ostiolatæ in verrucis compositis), ostiolis punctiformibus, demum sæpe impressis, 0·05 − 0·25 (−0·30) mm. latis, fuscis aut nigricantibus (aut in var. meizotoca *partim pallide olivaceis). Paraphyses ramoso-connexæ. Asci clavati, ad 340 μ longi et 45 − 65 μ lati. Sporæ singulæ aut raro binæ (in var.* meizotoca *vulgo binæ, rarius singulæ aut ternæ, rarissime quaternæ), uniseriatæ, primum decolores, mox aut demum olivaceo-virescentes (plasmate sordide æruginose tincto, KHO + violascenti), 120 − 195* x *37 − 65 μ, membrana incolorata, 4 − 9 μ crassa (apicibus sæpe magis incrassata), intus sat valide transversim et subreticulatim costulata. Thallus extus intusque KHO + flavescens,* $CaCl_2O_2$ *−, PD −; verrucæ fertiles intus PD + aurantiaco-rubentes. Hyphæ medullares I −. Corticola.*

Description of the holotype-specimen: Thallus forming effuse patches 4 to 7 cm. diam. on the smooth bark; margin where free, effuse and indistinct, where adjoining other crustaceous lichens, limited by a thin black line. Thallus thin, 0·1 to 0·2 mm., continuous or indistinctly reticulate-rimose (not areolate), yellowish-glaucescent or pale greenish with a faint stramineous tinge, matt, smooth or slightly uneven, without isidia or soredia, externally and internally KHO + persistent yellow, $CaCl_2O_2$ −, PD −; medulla I −. Thallus sections under microscope KHO + yellow mist.

Fertile verrucæ scattered, single or 2 to 3 coalescent, hemispherical to subglobose, ± well constricted at base, concolorous with the thallus, 0·7 to 1·0 mm. diam., or up to 2 (−2·5) mm. when confluent, each with 1 to 3 ostioles (or up to 12 ostioles in compound verrucæ); KHO + yellow and CaC_2lO_2 − as in the thallus, but PD + internally orange-red. Ostioles punctiform, usually impressed, about 0·1 mm. diam., pale to grey or blackish, not pruinose or farinose. Paraphyses branched and anastomosing, 1·0 to 1·5 (−2·5) μ thick. Asci clavate, up to 340 μ long, 45 to 65 μ broad, with hyaline, non-striated wall 7 to 9 μ thick at sides, thickened up to 22 μ at apex. Spores usually solitary in ascus, rarely 2 (uniseriate); soon olivaceous-greenish (like the epithecium of *Lecanora* sect. *Aspicilia*-species), KHO + violet then sordid olive-brownish, the wall itself colourless, about 9 μ thick (slightly thicker at the ends), smooth on outer side, on inner side strongly transversely and subreticulately furrowed or costulate. Spores 120 to 195 x 38 to 65 μ.

Var. **meizotoca** M. Lamb (n. var.) Plate III, lower figure, part of Plate II.

Victoria Co.: Baddeck, on trunk of tree, coll. J. Macoun, July 9, 1898 (No. 1953 pr. p.). associated with *Pertusaria neoscotica*, the whole recorded by Macoun, 1902, p. 120, as *Pertusaria communis*. Fert.

Differt ascis vulgo bisporis, rarius monosporis aut trisporis, rarissime etiam quadrisporis.— Crusta crassior quam in typo, ad 0·4 (−0·5) mm. crassus, partim distinctius rimosus (fere areolatus). Ostiola sæpe pallidiora (olivacea), mox bene impressa. Sporæ diutius hyalinæ, demum sordide olivaceo-æruginascentes et formam magnitudinemque cum iis speciei typicæ bene congruentes.

Description of the type-specimen: Thallus subdeterminate, in patches 1·5 to 3·0 cm. diam., up to 0·4 (−0·5) mm. thick, cream-coloured or whitish with a faint stramineous tinge, matt, in the thinner parts indistinctly reticulate-rimose, in the thicker parts distinctly rimose or almost areolate, smooth or verrucose-uneven. No distinct hypothallus. Thallus KHO + yellow or yellowish, $CaCl_2O_2$ −, PD −. Medulla I −.

Fertile verrucæ scattered or crowded, single or often confluent, irregularly subglobose, well constricted at base, 0·8 to 1·5 mm. diam. when simple, up to 2·5 mm. diam. when confluent, slightly more yellowish than the thallus, each with 1 to 4 ostioles (or up to 12 ostioles in compound verrucæ). Ostioles at first minutely punctiform, about 0·05 mm. diam., level with the surface, grey to blackish, then widening to 0·10 to 0·25 (−0·30) mm. diam., strongly impressed, and paler (olivaceous). Fertile verrucæ KHO + yellow or yellowish, PD + orange. Spores mostly 2 per ascus, sometimes 1 or 3, very rarely 4, uniseriate, a long time colourless, but finally olive-greenish or sordid æruginose (KHO + violet or violet-purple), 120 to 170 (−195) x 37 to 45 (−50) μ; spore-wall 4 to 9 μ thick, often thicker at ends (up to 20 μ), colourless, on inner side strongly transversely or subreticulately costulate.

The genus *Melanaria* was established by Erichsen, 1936, p. 680, for those species, previously placed under *Pertusaria*, in which the spores are dark coloured at maturity and stain violet with KHO. No type-species was designated, and probably *M. spilomantha* (Nyl.) Erichs., the species first mentioned, should be regarded as the lectotype (pseudotype). Erichsen lists the following species of *Melanaria: M. spilomantha* (Nyl.) Erichs., *M. urceolaria* (Nyl.) Erichs., *M. lactescens* (Mudd) Erichs., *M. pentelici* (Stnr. Erichs. (all from Europe), *M. aperta* (Stizenb.) Erichs. and *M. leonina* (Stizenb.) Erichs. (from S. Africa), *M. calcarea* (Nyl.) Erichs. and *M. melanospora* (Nyl.) Erichs. (from S. America). All these are saxicolous species, with indistinctly formed or absent fertile verrucæ and 1 to 2 spores in the ascus, which characters were also included by Erichsen in his diagnosis of *Melanaria*. But there is at least one other corticolous species of the genus besides *M. macounii*, namely *M. subochracea* (Stirt.) M. Lamb, **n. comb.** (Syn. *Pertusaria subochracea* Stirt. in Proc. Philosoph. Soc. Glasgow, XI, 1879, p. 312), from India; the writer has seen no type-specimen, but Stirton's description is perfectly clear: "sporæ (4 — 6 — 8?) næ nigrescentes ellipsoideæ simplices . . . . K. protoplasma sporarum sordide violascens". The fertile verrucæ are, according to Stirton's description, distinct, subhemispherical. It therefore seems necessary to emend Erichsen's diagnosis of the genus as follows:

Melanaria Erichs. *emend.* M. Lamb

Thallus crustaceus. Apothecia thallo immersa (verrucis fertilibus haud aut parum distinctis) aut in verrucis bene prominentibus inclusa. Asci 1-6 (—8?)—*spori. Sporæ magnæ, obscuratæ, KHO + violascentes. Cæteris notis ut in* Pertusaria. *Saxicola vel corticola.*

The following species, in addition to those mentioned above, also belong to *Melanaria*: *M. amaurospora* (Hellb.) M. Lamb, **n. comb.** (Syn. *Pertusaria amaurospora* Hellb. in Bih. Svensk. Vet.-Akad. Handl., XXI, Afd. III, No. 13, 1896, p. 73. New Zealand, saxicola. Omitted in Zahlbruckner's Cat. Lich. Univ.); *M. callispora* (Zahlbr.) M. Lamb, **n. comb.** (Syn. *Pertusaria callispora* Zahlbr. in Denkschr. Akad. Wiss. Wien, math.-naturw. Kl., CIV, 1941, p. 86. New Zealand, saxicola); *M. ochracea* (Kphbr.) M. Lamb, **n. comb.** (Syn. *Pertusaria ochracea* Kphbr. in Flora, LVI, 1873, p. 472, Chile, saxicola); *M. phæosporina* (Zahlbr.) M. Lamb, **n. comb.** (Syn. *Pertusaria phæosporina* Zahlbr. in Hedwigia, LXXIV, 1935, p. 204. China, corticola); *M. tesselaria* (Müll. Arg.) M. Lamb, **n. comb.** (Syn. *Pertusaria tesselaria* Müll. Arg. in Nuov. Giorn. Bot. Ital., XXI, 1889, p. 357. Brazil, saxicola). It is possible that also *Pertusaria rugifera* Müll. Arg. (in Miss. Scient. Cap Horn, V, 1889, p. 163) may be a *Melanaria*, for Müller Arg. there states "Sporae subinde ludunt intus nigrescentes".

LECANORACEAE

Lecanora (Eulecanora) **chlarona** (Ach.) Nyl. *emend.* H. Magn.

Inverness Co.: Craigmore, alt. *circ.* 120 m.s.m., on standing trunk of dead tree in mixed woods, associated with *Haematomma ochrophaeum*, coll. I.M.L., June 13, 1952 (No. 6646). Fert.—Vicinity of Whycocomagh, alt. *circ.* 165 m.s.m., on trunk of *Acer* beside trail through open mixed woods, coll. I.M.L., Aug. 21, 1952 (No. 7024). Fert.

Victoria Co.: vicinity of Baddeck (no exact locality on the label, but the date indicates Baddeck or vicinity), on smooth bark, coll. J. Macoun, July 27, 1898, mounted together with *L. laevis*, the whole recorded by Macoun, 1902, p. 106, as *L. subfusca* var. *allophana*. Fert.

The species of the *L. subfusca*-group, e.g. this one and *L. glabrata*, are now relatively easy to distinguish, thanks to the studies of Magnusson (1932) and Poelt (1952).

"*Lecanora subfusca* var. *coilocarpa*" recorded by Macoun, 1902, p. 107, is a *Rinodina*; see under *R. annulata* H. Magn.

Lecanora glabrata (Ach.) Malme

Inverness Co.: Craigmore, alt. *circ.* 135 m.s.m., on trunk of *Fagus* in mixed woods, coll. I.M.L., June 15, 1952 (No. 6668). Fert.

Victoria Co.: Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on trunk of *Fagus* at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6867). Fert.—Vicinity of Cape North, alt. *circ.* 65 m.s.m., on trunk of *Fagus* in mixed woods, coll. I.M.L., Aug. 1, 1952 (No. 6967). Fert.

L. glabrata here, as in Europe, seems to be confined exclusively to beech. In Scandinavia it is a distinctly southern species (Almborn, 1948, pp. 36-7).

Lecanora hageni (Ach.) Ach.

Inverness Co.: Craigmore, alt. *circ.* 25 m.s.m., on wooden shingles of wall of an old barn, associated with *Caloplaca vitellinula* f. *lignicola*, coll. I.M.L., June 19, 1952 (No. 6711 pr. p.). Fert.

Lecanora hypoptoides Nyl.

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 65 m.s.m., on a piece of weathered lignum between boulders on exposed mountainside, coll. I.M.L., June 30, 1952 (No. 6781). Fert.

Agrees well with the authentic material distributed in Norrl. and Nyl. Herb. Lich. Fenn. No. 125 (in Farlow Herb.), except that the thallus in the writer's specimen is better developed, verrucose-granulate, and gives in places a more or less distinct red reaction with $CaCl_2O_2$; in the exsiccat cited no distinct $CaCl_2O_2$ reaction could be obtained.

L. hypoptoides has already been recorded from Canada (Province of Quebec) by Lepage (1949, sep. pag. 386), and was found in U.S.A., N. Carolina, by Degelius (1941, p. 53).

Lecanora intricata (Schrad.) Ach.

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 65 m.s.m., on exposed granitic rocks on mountainside, associated with *L.* (*Aspicilia*) *cinerea* and *Rhizocarpon distinctum*, coll. I.M.L., June 30, 1952 (No. 6784 pr. p.). Fert.

Victoria Co.: Cape North, Gray Glen, Burnt Mountain, on stones of scree, associated with *Lecidea cyanea* and *Rhizocarpon geographicum*, coll. J. S. Erskine, July 10, 1952 (No. 52 C 2074 pr. p.). Fert.

Lecanora lævis Poelt (in Ber. Bayer. Bot. Ges., XXIX, 1952, p. 64).

Victoria Co.: vicinity of Baddeck (no exact locality given on label, but the date indicates Baddeck or vicinity), on lignum of a log, coll. J. Macoun, July 27, 1898, mounted together with *L. chlarona*, the whole recorded by Macoun, 1902, p. 106, as *L. subfusca* var. *allophana*. Fert.

New to Canada. An interesting find. This recently described species of the *L. subfusca*-group was previously known only from Southern Europe and North Africa, where it appears to be a Mediterranean-Atlantic distributional type; one specimen, however, was seen from as far north as South Germany (Böhmerwald). Macoun's plant was compared with Flagey, Lich. Alger. No. 113 ("*Lecanora subfusca* v. *glabrata*") in the Farlow Herbarium, this exsiccat being the type material of *L. lævis*, and was found to show very good agreement, both in external morphology and microscopic characters. *L. lævis* outwardly resembles the saxicolous

L. campestris (Schaer.) Hue, and is characterized by the smooth, subnitid, not inflexed apothecial margin, negative PD reaction, the gelatinous apothecial cortex entirely inspersed with sordid granules, and the absence of large crystals in the apothecial margin and of granules in the epithecium. It seems to belong to the *subrubra*-section of the *subfusca*-group, having the same general structure of the apothecial margin (cf. Magnusson, 1932, pp. 68, 85). The chief difference seems to be in the distinctness of the cortical layer of the apothecial margin; in *L. lævis* (Flag. Lich. Alger. 113 and Macoun's specimen), the cortex is (15−) 20 to 48 μ thick, entirely inspersed with small sordid yellowish or yellow-brownish granules; the inner part of the margin is inspersed with sordid yellowish-grey granules and minute crystals which are somewhat different in colour from those of the cortex, so that the latter is clearly distinguishable in section. In *L. subrubra*, on the other hand, the cortex and the inner part of the apothecial margin are both equally inspersed with the same kind of sordid dark yellowish or yellow-brownish granules, so that the limit between them is quite indistinct, as described by Magnusson, loc. cit., and also found by the writer in Vainio, Lich. Bras. Exs. No. 943 (*"Lecanora subfusca* var. *glabrata"*) which is authentic material of one of the varieties of *L. subrubra* described by Hue.

L. lævis will probably prove to have a more extensive distribution than is indicated by the few localities known at present.

Lecanora pallida (Schreb.) Rabh.

Inverness Co.: Craigmore, alt. *circ.* 85 m.s.m., on trunk of *Acer* on sparsely wooded hillside, associated with *Lobaria verrucosa*, coll. I.M.L., June 12, 1952 (No. 6613). Fert.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on bark of dead standing *Abies* in open mixed woods, coll. I.M.L., June 22, 1952 (No. 6731). Fert.

Victoria Co.: Baddeck, on *Abies*, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 106). Fert.—Franey Mountain trail near Ingonish, alt. *circ.* 165 m.s.m., on trunk of *Fagus* beside trail through mixed woods, coll. I.M.L., Aug. 6, 1952 (No. 6984). Fert.—Near Sunset Cape North, alt. *circ.* 65 m.s.m., on trunk of *Quercus* in light mixed woods, coll. I.M.L., July 31, 1952 (No. 6962). Fert.

Lecanora polytropa (Ehrh.) Rabh.

Inverness Co.: Craigmore, alt. *circ.* 150 m.s.m., on metamorphic rock outcrop in hillside pasture, coll. I.M.L., June 16, 1952 (No. 6691). Fert.—Cape Breton Highlands Park, near the Cheticamp entrance, alt. *circ.* 50 m.s.m., on loose stones on bank at side of trail through mixed woods, coll. I.M.L., July 5, 1952 (No. 6847). Fert.

Cape Breton Co.: Vicinity of North Sydney, alt. *circ.* 85 m.s.m., on sandstone rocks in open heathy pasture, coll. I.M.L., Aug. 19, 1952 (No. 7016). Fert.

No. 6847 from Cape Breton Highlands Park is the f. *illusoria* (Ach.) Leight.

Lecanora symmicta (Ach.) Ach.

Inverness Co.: Margaree, on old wooden rails, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 110, *s.n. L. varia* var. *symmicta*). Fert.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 135 m.s.m., on trunk of *Acer* beside trail through mixed woods, associated with *Parmelia subaurifera* and *Buellia punctata*, coll. I.M.L., Aug. 6, 1952 (No. 6997 pr. p.). Fert.

[*Lecanora varia* (Ehrh.) Ach.

Recorded from Inverness Co., Margaree, by Macoun, 1902, p. 109, but no corresponding specimen could be found in the National Herbarium.]

Lecanora sp.

Cape Breton Co.: Mainadieu, on the shoreward side of marine rocks at the extreme point, about 3 m. above the sea, in the lower hygrohaline, associated with *Caloplaca* f. *marina* var. *flavogranulata,* coll. I.M.L., July 23, 1952 (No. 6918). Fert.

Resembling *L. campestris* (Schaer.) Hue, but differing in the darker brown (not reddish) colour of the disks and also anatomically (cortex of apoth. margin clear and hyaline, epithecium partly olivaceous-brown), and certainly not that species. Neither is it *L. poliophæa* (Wbg.) Schaer., which has a more finely granulose-verruculose thallus, nor *L. salina* H. Magn., which has much smaller apothecia and a more meagre thallus. I am unable to determine it at present.

Lecanora (Aspicilia) **cinerea** (L.) Röhl.

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 65 m.s.m., on exposed granitic rocks on mountainside, often associated with *Lecidea cyanea, Lecanora intricata, Rhizocarpon distinctum,* and *Rh. geographicum,* coll. I.M.L., June 30, 1952 (Nos. 6780, 6784 pr. p., 6785 pr. p.). Fert.—Between Cheticamp and Cap Rouge, alt. *circ.* 35 m.s.m., on large rock by the roadside, coll. I.M.L., July 1, 1952 (No. 6807). Fert.—Same locality, alt. *circ.* 50 m.s.m., on large rock in partial shade of trees in a stream-gully, associated with *Caloplaca flavovirescens,* coll. I.M.L., July 3, 1952 (No. 6829). Fert.

The medulla in this species is KHO + yellow then red (with formation of crystals), PD + persistent golden-yellow; probably due to Norstictic acid.

Lecanora lævata (Ach.) Nyl.

Victoria Co.: Ingonish, Middle Head, alt. *circ.* 25 m.s.m., on large granite boulders beside pathway through spruce woods, covering extensive areas of the rock, coll. I.M.L., July 29, 1952 (No. 6949). Fert.

In *L. lævata* the medulla is KHO + yellow (yellow mist under microscope), PD + orange to orange-red, as well seen, for example, in Arnold, Lich. Monac. Exs. No. 236 ("*Aspicilia silvatica*"). These reactions serve to distinguish it from other closely similar species, such as *L. lævatoides* H. Magn. and *L. obscurata* (Fr.) Nyl., in which they are negative.

Lecanora (Placodium) **microbola** M. Lamb (n. sp.) Plate IV.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on a large stone near the seashore, on site of the outer fortifications, scarce, without accompanying species, coll. I.M.L., July 19, 1952 (No. 6897). Very sparingly fert.

Thallus sordide stramineus, opacus, nudus, plagas effiguratas 2 – 4 centim. latas formans, ambitu concinne et regulariter laciniatus, in centro minute granuloso-concrescens, diffractus et ad 0·8 (—1·0) mm. crassus; laciniæ marginales saxo arcte adnatæ, lineares, 1·5 – 2·5 (—3·0) mm. longæ, 0·2 – 0·3 (—0·5) mm. latæ, alte convexæ aut subteretes, contiguæ, parum ramoso-divisæ, extremitatibus vulgo anguste obscuriores (fuscescentes). Cortex tantum latere superiori evolutus, 17 – 25 μ crassus. Apothecia (rarissima) minuta, ad circ. 0·2 mm. lata, sessilia, rotundata, margine thallino prominenti et integro circumdata, disco subimpresso, fusco aut fusconigro, nudo. Hypothecium incoloratum, hymenium circ. 50 μ altum, superne obscure fuscescens, paraphysibus conglutinatis et apicibus capitatis. Sporæ 8næ, decolores, simplices, ellipsoideæ, minutæ, 10·0 – 11·5 x 4 – 5 μ. Thallus KHO— aut magis flavescens, $CaCl_2O_2$ *+ aurantiaco-rubescens, PD—.*

—*Ad speciem japonicam* L. perconcinnam *Hue habitu persimilem maxime accedit, a qua præsertim apotheciis minutissimis et nudis et sporis minoribus distinguitur. Saxicola ad scopulos maritimos.*

Thallus forming discrete or confluent, ± orbicular rosettes or patches 2 to 4 cm. diam., minutely laciniate-effigurate at periphery, in central parts minutely concrescent-granulose and ± diffract (not areolate); sordid stramineous-yellowish, matt, not pruinose. Peripheral laciniæ closely applied to the stone, linear, contiguous, not imbricated, 1·5 to 2·5 (−3·0) mm. long, 0·2 to 0·3 (−0·5) mm. broad, strongly convex (±terete), sparingly dichotomously or irregularly branched, at the extreme tips usually brownish, rounded, not or only slightly broader; their surface smooth. Central parts of thallus up to 0·8 (−1·0) mm. thick, forming an irregularly diffract crust, the concrescent granules 0·1 to 0·2 mm. diam. Medulla white, I −. Thallus externally and internally KHO − or more yellow, $CaCl_2O_2$ + orange to orange-red, PD −. Upper cortex of laciniæ 17 to 25 μ thick, sordid yellowish-grey-nubilated and ± opaque in section, with indistinct cells 3 to 5 μ diam., at tips of laciniæ ± brown-pigmented in outer 6 to 12 μ. Underside of thallus without cortex. Algal stratum ± interrupted, diffuse, 65 to 100 (−120) μ deep; algæ protococcoid, 7 to 12 μ diam. Medulla 65 to 120 μ deep, heavily inspersed with sordid yellowish-grey granular substance and ± opaque in section, composed of indistinct, closely intertexted hyphæ 3 to 5 μ thick. Sections of thallus in KHO become clear with yellow mist; in $CaCl_2O_2$ clear with intense orange-red mist from all tissues.

Only one apothecium present, removed for sectioning; sessile on thallus, minute, 0·2 mm. diam., with plane or slightly concave, sunken, naked, dark brown or brown-blackish disk and prominent, entire thalline margin concolorous with the thallus. In spite of its small size, it was fully mature with well developed hymenium and spores. Apothecial margin containing algæ (also below the hypothecium), corticate, cortex 15 to 25 μ thick, similar to that of thallus. No inner exciple developed. Hypothecium bowl-shaped, colourless, hyaline, about 70 μ deep, composed of fine, gelatinized and variously intricated hyphæ 1·5 to 3·0 μ thick. Hymenium 50 μ high, gradually dark brown in uppermost 6 to 10 μ, otherwise colourless and clear, without granules. Paraphyses concrete, embedded in mucilage, simple or branched, 1·2 to 1·5 μ thick, the tips either distinctly capitate (to 4 μ) or included in the common, gelatinous, brownish epithecial layer. Asci clavate, 37 to 45 x 10 to 12 μ, with wall about 1·5 μ thick. Spores 8næ, irregularly biseriate in ascus, escaping easily, simple, colourless, ellipsoid (rarely bean-shaped), 10·0 to 11·5 x 4 to 5 μ, with distinct smooth wall about 0·7 μ thick.—Hymenium blue then greenish-blue with Iodine.

It agrees so well in many respects with the description of *L. perconcinna* Hue from Japan (Ann. Mycol. XII, 1914, p. 519) that the writer was first inclined to place it as a variety under that species. Unfortunately his attempts to obtain one of Hue's authentic specimens for comparison were unsuccessful. From Hue's detailed description, there seem to be certain differences, tabulated below, which indicate that they are distinct species.

L. perconcinna	*L. microbola*
Upper cortex 40 to 80 μ thick, covered by an amorphous layer 12 to 15 μ deep.	Upper cortex 17 to 25 μ thick, without amorphous layer.
Lower cortex developed, 20 μ thick, similar to upper.	No lower cortex developed.
Apothecia numerous, often crowded and angulose, 0·5 to 1·0 mm. diam.; margin ± crenulate; disk slightly pruinose.	Apothecia very scarce, solitary, minute, up to about 0·2 mm. diam.; margin entire; disk naked.
Cortex of apoth. margin 40 to 60 μ thick.	Cortex of apoth. margin 15 to 25 μ thick.
Lateral perithecium (inner exciple) present.	No lateral perithecium (inner exciple) developed.
Spores 11 to 13 x 6·0 to 7·5 μ.	Spores 10·0 to 11·5 x 4 to 5 μ.

L. microbola seems to be related to *L. straminea* (Wbg.) Ach., and has the same ecology, being a hygro- or aëro-haline species occurring on rocks by the seashore.

Candelariella vitellina (Ehrh.) Müll. Arg.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of loose stones on site of the fortifications, occurring as scanty intermixture with *Lecidea albidocinerella* and *Parmelia sulcata*, coll. I.M.L., July 19, 1952 (No. 6903 pr. p.). Fert.

Ochrolechia androgyna (Hoffm.) Arn.

Inverness Co.: Craigmore, alt. *circ.* 100 m.s.m., on large metamorphic rock in open mixed woods, coll. I.M.L., June 13, 1952 (No. 6651). Ster.

Victoria Co.: Baddeck, on trees in woods, associated with *Pertusaria velata*, *P. amara*, an indeterminable *Pertusaria*-species, and *Lecidea helvola*, coll. J. Macoun, July 9, 1898, the whole recorded by Macoun, 1902, p. 119, as *Pertusaria velata*. Ster.

Scattered subglobose soredia $CaCl_2O_2$ + rose-red.

Another sterile specimen, collected by Macoun at Baddeck on the same day, had been named first "*Pertusaria*", then "*Lecanora tartarea*" on the label, and is not mentioned in Macoun's Catalogue.

Icmadophila ericetorum (L.) Zahlbr.

Inverness Co.: Craigmore, alt. *circ.* 100 m.s.m., on a decaying mossy log in open woods, coll. I.M.L., June 13, 1952 (No. 6647). Fert.—MacGregor Mountain above Cabot Trail, alt. 1,500 feet, over mosses in bog, coll. J. S. Erskine, Aug. 7, 1950 (No. 50 C 1535). Fert.

Victoria Co.: Baddeck, on mosses in woods, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 140 *s.n. Baeomyces aeruginosus*). Fert.

Hæmatomma ochrophæum (Tuck.) Mass.

Inverness Co.: Craigmore, alt. *circ.* 120 m.s.m., on standing trunk of dead tree in mixed woods, associated with *Lecanora chlarona*, coll. I.M.L., June 13, 1952 (No. 6646a). Fert.

Victoria Co.: Baddeck, on *Picea*, coll. J. Macoun, July 29, 1898 (Macoun, 1902, p. 111, *s.n. Lecanora elatina*). Fert.

Spores curved or sigmoid, completely eseptate, as they are also in Tuckerman's type-specimen from the White Mountains in Farlow Herb. In the related *H. elatinum* they are also often eseptate, and for this reason Massalongo made the latter species the type of a distinct genus, *Loxospora*, in Ricerch. Auton. Lich. Crost. (1852), p. 137. In Japanese material of *H. ochrophæum* the spores are 60 to 85 μ long, according to Nylander, Lich. Japon. (1890), p. 49, and Räsänen in Jour. Jap. Bot. XVI (1940), p. 89; in Tuckerman's type-specimen and our Canadian material they are shorter, 40 to 65 x 5 to 6 (−7) μ.

PARMELIACEAE

Parmeliopsis ambigua (Wulf.) Nyl.

Inverness Co.: Big Intervale, on dead spruce logs, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 73, *s.n. Parmelia ambigua*). Ster.

Parmeliopsis hyperopta (Ach.) Arn.

Inverness Co.: Big Intervale, on old fence rails, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 74, *s.n. Parmelia ambigua* var. *albescens*). Ster.

Parmelia (Hypogymnia) **physodes** (L.) Ach.

Var. **labrosa** Ach.

Inverness Co.: Big Intervale, on trees in woods, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 69, *s.n. P. physodes* var. *vulgaris*). Fert.—Craigmore, alt. 120 to 200 m.s.m., on twigs of dead fallen spruce trees, and on cut surfaces of old stumps in mixed woods, coll. I.M.L. June 13 and 16, 1952 (Nos. 6637, 6681). Ster.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on the ground over mosses at foot of talus slope, coll. I.M.L., July 3, 1952 (No. 6815). Ster.

Victoria Co.: Baddeck, on trunks in woods, coll. J. Macoun, July 9, 1898, distributed as admixture with *P. saxatilis* var. *divaricata* in Macoun's Canad. Lich. No. 43 (*"Parmelia saxatilis* var. *laevis"*). Ster.—Ingonish, Middle Head, alt. *circ.* 25 m.s.m., on dead spruce twigs on headland, coll. I.M.L., July 29, 1952 (No. 6944). Ster.

F. **vittatoides** Mer.

Inverness Co.: Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on trunk of old *Betula* by roadside, associated with *Cetraria glauca*, coll. I.M.L., June 22, 1952 (No. 6719 pr. p.). Ster.

Parmelia (Euparmelia) **caperata** (L.) Ach.

Var. **cylisphora** Ach.

Inverness Co.: Craigmore, alt. *circ.* 35 m.s.m., on metamorphic block on open hillside, coll. I.M.L., June 12, 1952 (No. 6611). Ster.

Parmelia centrifuga (L.) Ach.

Victoria Co.: Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., on rocks and boulders of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6982). Ster.

Parmelia cetrarioides Del. *emend.* DR.

Inverness Co.: Big Intervale, on tree trunks, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 67, *s.n. P. perlata*). Ster.

The specimen represents the active chemical phase of the species with medulla $CaCl_2O_2$ + red (var. *rubescens* (Th. Fr.) DR. in Nyt Mag. f. Naturvidensk. LXII, 1924, p. 75).

As was to be expected, the material under "*Parmelia perlata*" in the National Herbarium comprises a mixture of species; a specimen thus named from southern Nova Scotia, Yarmouth, coll. J. Macoun, 1910, for instance, is *P. trichotera* Hue *emend.* DR. Cf. the paper of Du Rietz, 1924.

Parmelia conspersa (Ehrh.) Ach.

Inverness Co.: Big Intervale, on boulders, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 73). Ster., with numerous pycnidia.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 35 to 50 m.s.m., on exposed granitic and metamorphic rocks on open hillside, somewhat abundant, coll. I.M.L., June 30 and July 5, 1952 (Nos. 6782, 6842). The latter fert.

The writer's specimens from Cape Breton Highlands Park are the typical isidiate form of the species, with medulla KHO + (slowly) orange-red, PD + intense orange. Macoun's specimen from Big Intervale belongs to the f. *imbricata* (Mass.) Zahlbr.

Parmelia disjuncta Erichs. (Syn. *P. granulosa* Lynge *non* Mart.; *P. sorediata* var. *coralloidea* Lynge; *P. granulosula* Oxner).

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. 35 to 50 m.s.m., on exposed granitic and metamorphic blocks, coll. I.M.L., July 5, 1952 (Nos. 6843, 6848). Ster.

Parmelia fuliginosa (Fr.) Nyl.

Var. **laetevirens** (Flot.) Nyl.

Inverness Co.: Craigmore, alt. *circ.* 120 m.s.m., on dead standing spruce trunk in mixed woods, coll. I.M.L., June 13, 1952 (No. 6634). Fert.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on trunk of *Picea* at edge of woods, coll. I.M.L., June 25, 1952 (No. 6750). Ster.

Parmelia incurva (Pers.) Fr.

Cape Breton Co.: Mainadieu, on top of cliffs about 10 m. above the sea, coll. I.M.L., July 23, 1952 (No. 6917). Ster.

[*Parmelia olivacea* Nyl.

This species was recorded by Macoun, 1902, p. 71, from Victoria Co., Baddeck, and Inverness Co., Big Intervale. The specimen from Big Intervale proved to be *P. subaurifera* Nyl., and that from Baddeck is not now present in the National Herbarium. It is therefore doubtful whether *P. olivacea* occurs in Cape Breton.]

Parmelia omphalodes (L.?) Ach.

F. **cinereoalbida** (Harm.) Zahlbr.

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 35 m.s m., on exposed granitic blocks on mountainside, coll. I.M.L., June 30, 1952 (No. 6788). Ster.

Victoria Co.: Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., on rocks and boulders of talus slope on mountainside, coll. I.M.L., Aug. 3, 1952 (No. 6980). Fert.

Cape Breton Co.: East side of St. Andrew Channel between Barachois and George River, alt. *circ.* 30 m.s.m., on a large rock face by the roadside, coll. I.M.L., July 22, 1952 (No. 6913). Ster.

Macoun's record of "*P. saxatilis* var. *omphalodes*", 1902, p. 69, refers to *P. saxatilis* f. *furfuracea*.

Parmelia panniformis (Nyl.) Vain.

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 85 m.s.m., on exposed granitic boulder on rocky slope, coll. I.M.L., July 1, 1952 (No. 6806). Ster.

Parmelia rudecta Ach.

Inverness Co.: Big Intervale, on old fence rails, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 68, *s.n. P. Borreri* var. *rudecta*). Ster.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on trunk of *Ulmus* by the roadside, associated with *Physcia ascendens*, coll. I.M.L., June 25, 1952 (No. 6761). Ster.

Parmelia saxatilis (L.) Ach.

Inverness Co.: Big Intervale, on *Betula*, coll. J. Macoun, July 15, 1898 (Macoun, 1902, p. 68, without mention of the exact locality). Fert.—Cape Breton Highlands Park, near Cap Rouge, alt. 50 to 85 m.s.m., on exposed granitic boulders and over mosses in crevices between same, coll. I.M.L., June 30, and July 1, 1952 (Nos. 6778, 6798 pr. p.). Ster.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on branch of dead standing *Abies* in open mixed woods, coll. I.M.L., June 22, 1952 (No. 6722). Fert.

Victoria Co.: Ingonish, Middle Head, alt. *circ.* 25 m.s.m., on granite boulders beside trail through spruce woods, coll. I.M.L., July 29, 1952 (No. 6948). Ster.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of stones near the seashore on site of the fortifications, associated with *P. sulcata*, coll. I.M.L., July 19, 1952 (No. 6896 pr. p.). Ster.

F. **furfuracea** (Schaer.) Linds.

Cape Breton Co.: Louisburg, on rocks, coll. J. Macoun, July 18, 1898 (Macoun, 1902, p. 69, *s.n. P. saxatilis* var. *omphalodes*). Ster.—Same locality, alt. *circ.* 5 m.s.m., on exposed rocks and stones on site of the fortifications, coll. I.M.L., July 19, 1952 (No. 6901). Ster.

Very abundant on the site of the fortifications at Louisburg, being the dominant lichen there, partly transitional to the following form.

F. **nigrescens** (Britzelm.) Hillm.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of loose stones on site of the fortifications, exposed position, coll. I.M.L., July 19, 1952 (Nos. 6899, 6902). Ster.

Var. **Aizoni** Del.

Inverness Co.: Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 35 m.s.m., on exposed granitic rocks, coll. I.M.L., June 30, 1952 (No. 6787). Ster.

Var. **divaricata** Del. ex Nyl. Plate V.

Inverness Co.: Craigmore, alt. 85 to 135 m.s.m., on trunks of *Picea* in open mixed woods, coll. I.M.L., June 12 and 13, 1952 (Nos. 6607, 6633). Fert.—Vicinity of Margaree Forks, alt. *circ.* 85 m.s.m., on trunks of *Abies* and *Betula* in mixed woods and by the roadside, abundant, coll. I.M.L., June 22 and 23, 1952 (Nos. 6723, 6742). Usually fert.

Victoria Co.: Baddeck, on trunks in woods, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 68, *s.n. P. saxatilis*, without mention of the exact locality, and distributed—with admixture of *P. physodes* var. *labrosa*—in Canad. Lich. No. 43, *s.n.P. saxatilis* var. *lævis;* also distributed, with admixture of *P. sulcata*, in Canad. Lich. No. 41, *s.n. P. saxatilis*, without exact locality on the label, but the date given indicates that it was collected in the vicinity of Baddeck).—Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on trunk of *Betula* at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6858). Fert.—Cape North near Bay St. Lawrence, alt. *circ.* 330 m.s.m., on trunk of *Betula* in open mixed woods, coll. I.M.L., Aug. 3, 1952 (No. 6970). Fert.

Our specimens (Plate V) agree very well with Nylander's (original ?) description in Lich. Japon. (1890), p. 28: "laciniis linearibus magis discretis, divaricato-divisis, subangustioribus, lævibus, sæpe transversim fissis, isidio vix ullo (vel marginali parculo, parum evoluto)". Nylander,

loc. cit., ascribes the epithet *divaricata* to Delise, but the writer cannot trace any earlier publication of the name. A small Japanese specimen sent from herb. Nylander (No. 34858), collected by Maries, and written up by Nylander as "*P. sulcata* f. *divaricata* Del ?" is not *P. saxatilis*, but a species of the *P. lævigata*-group. The specimen referred to in Lich. Japon. was collected by Almquist at Itchigomé, and the writer has not seen it. In the Farlow Herbarium there is a specimen on birch bark from Japan, Yezo, Sapporo, coll. Faurie, 1893 (No. 9222), determined by Hue as *P. saxatilis* var *divaricata*, and it agrees very well with our Cape Breton material. Asahina, 1952, Pl. XV, fig. 2, also illustrates a quite similar specimen under this name.

P. saxatilis var. *angustifolia* Nyl. ex Hue, 1901, p. 164, seems from the description given to be indistinguishable from var. *divaricata*; it was described from Newfoundland (coll. de la Pylaie, in herb. Bory) and Miquelon (coll. Delamare). The writer has seen no authentic specimen.

This may also be the unnamed corticolous form mentioned from Tennessee, North Carolina, and Maine by Degelius, 1941, p. 65.

Typical specimens of this variety are also present in the National Herbarium from Quebec, Anticosti Island, coll. J. Macoun, 1883, and British Columbia, Vancouver Island, coll. J. Macoun, 1887.

Parmelia sorediata (Ach.) Röhl.

Inverness Co.: Craigmore, alt. *circ.* 35 m.s.m., on metamorphic blocks on open hillside, coll. I.M.L., June 12, 1952 (No. 6622). Ster.—Cape Breton Highlands Park, near Cap Rouge, alt. *circ.* 65 m.s.m., on large exposed granitic rock, coll. I.M.L., June 30, 1952 (No. 6779). Ster.

Macoun, 1902, p. 71, records "*P. olivacea* var. *sorediata*" from Victoria Co., Baddeck; this perhaps refers to the present species, but the specimen cited could not be found in the National Herbarium.

Parmelia stygia (L.) Ach.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on metamorphic blocks of talus slope at foot of cliffs, coll. I.M.L., July 3, 1952 (No. 6826). Fert.

Parmelia subaurifera Nyl.

Inverness Co.: Big Intervale, on *Alnus*, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 71, *s.n. P. olivacea*). Ster.—Craigmore, alt. *circ.* 85 m.s.m., on trunk of *Prunus* on hillside, coll. I.M.L., June 12, 1952 (No. 6612). Ster.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 65 m.s.m., on trunk of *Betula* in a stream-gully, coll. I.M.L., July 3, 1952 (No. 6820). Ster.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 135 m.s.m., on trunk of *Acer* beside trail through mixed woods, coll. I.M.L., Aug. 6, 1952 (No. 6997 pr. p.). Ster.

Parmelia subquercifolia Hue

Victoria Co.: Baddeck, on *Fagus*, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 68, *s.n. P. tiliacea*). Fert. (Macoun, loc. cit., gives the locality as Big Intervale, Margaree, but the specimen in the National Herbarium is labelled "Baddeck".)

New to Canada.

Laciniæ 0·8 to 1·5 (−2·0) mm. wide. Thallus externally KHO + yellow, $CaCl_2O_2$ −, PD −; medulla KHO + yellow then orange-red, $CaCl_2O_2$ −, PD + yellow then orange or orange-red. Spores ellipsoid, 8·5 to 10·0 x 6 to 7 μ.

P. subquercifolia Hue is synonymous with *P. tiliacea* b. *sublævigata* Tuck. (*non* Nyl.). Macoun's specimen agrees well with one in herb. Tuckerman from S. Carolina, Santee Canal, called "*sublævigata*" by Tuckerman, and also with Tuckerm. Lich. Amer. Septentr. No. 70 ("*P. tiliacea*"), which is quoted by Hue, 1901, p. 157, as being *P. subquercifolia*. The true *P. sublævigata* Nyl. differs chiefly in its broader laciniæ, up to 7 mm. wide, according to Vainio, Lich. Brésil, I (1890), p. 53, and Hue, op. cit., p. 169. Asahina, however (1952, p. 97), places *P. subquercifolia* as a synonym of *P. sublævigata* Nyl.

Degelius, 1940, p. 48, lists *P. subquercifolia* from U.S.A., Maine, and suggests that *P. endoleuca* Tayl. should be examined as possibly conspecific. *P. endoleuca* was described from W. Australia, Swan River (near Perth), coll. J. Drummond (in Hooker's Lond. Jour. of Bot., VI, 1847, p. 167), and not from "America septentrionalis", as erroneously stated by Zahlbruckner in Cat. Lich. Univ. VI (1929), p. 166. The type-specimen in the Taylor herbarium (Farlow Herb.), annotated by Müller Arg. as *P. tiliacea* var. *minor* Müll. Arg., is similar in appearance to *P. subquercifolia*, but its thallus is KHO + yellow both externally and internally (the medulla not turning red), $CaCl_2O_2$ –, PD – (also in the medulla). The specimen is poor and, as stated by Müller Arg. in Flora, LXXI (1888), p. 198, largely decorticated. The different reactions seem to indicate a different species, although in habitus it much resembles *P. subquercifolia*. Apothecia abundant, up to 2·5 mm. diam., with reddish-brown or dark brown, matt or subnitid, naked disks. Spores broadly ellipsoid, 10 to 12 x 7·0 to 8·5 μ.

P. tiliacea var. *minor* Müll. Arg., described originally from U.S.A., Texas, coll. J. Boll (in Flora, LX, 1877, p. 78), is stated by Müller Arg. in Flora, LXXI (1888), p. 198, and by Zahlbruckner in Cat. Lich. Univ. VI (1929), p. 166, to be synonymous with *P. endoleuca* Tayl. Tuckerman, 1882, p. 57, considered it to be identical with *P. tiliacea* b. *sublævigata* (Tuck., *non* Nyl., *i.e. P. subquercifolia*). Hue, 1901, pp. 156, 157, however, dissented from this view, stating a difference in the chemical reaction of *P. tiliacea* var. *minor* Müll. Arg. (medulla KHO + persistent yellow), and therefore raised it to the rank of a separate species, to which he gave the nom. nov. *P. deminuta* Hue (p. 156). The writer was able to confirm Hue's statement concerning the reaction in a syntype-specimen of *P. tiliacea* var. *minor* sent by Müller Arg. to the Farlow Herbarium, obtaining the reactions: thallus externally KHO + yellow, $CaCl_2O_2$ –, PD –, medulla KHO + yellow (not turning red), $CaCl_2O_2$ –, PD + yellow to orange-yellow (not red). Spores very sparingly developed, apparently ellipsoid and about 9 to 10 x 5 to 6 μ. The general habitus quite similar to that of *P. subquercifolia*, and in the writer's opinion it is conspecific with the latter, at most a distinct chemical phase or strain of the species.

P. tiliacea var. *vicinior* (Hue) Merrill in Bryologist, XI (1908), p. 92, based on *P. vicinior* Hue, 1901, p. 156, has a similar persistent yellow KHO reaction of the medulla, and seems, at any rate in the sense of Merrill, to be the same as *P. tiliacea* var. *minor* above. Merrill, loc. cit., records a specimen of it from Cape Breton, but the writer has not seen it.

Another North American species, *P. livida* Tayl. (in Hooker's Lond. Jour. of Bot. VI, 1847, p. 171), described from New Orleans, closely resembles *P. subquercifolia*, differing chiefly in the glaucous-pruinose apothecia and transversely rugulose laciniæ (cf. Nylander, Synops. Lich. I, 1860, p. 383). In the type-specimen in herb. Taylor (Farlow Herb.) only one apothecium shows a distinct bluish pruina, the others have brown and naked disks. The laciniæ are ± convex-turgescent, often transversely rugose and with transverse cracks. In size and shape they agree with those of *P. subquercifolia.* No isidia or soredia. Apothecia large, up to 7 mm. diam.; spores ellipsoid, 8·5 to 10·0 x 5 to 6 μ (or according to Berry's revision in Ann. Mo. Bot. Gard. XXVIII, 1941, p. 106, 9 to 12 x 4 to 6 μ). Thallus externally KHO + yellow, $CaCl_2O_2$ −, PD −, medulla KHO + yellow then orange-red or dull red (not intense), $CaCl_2O_2$ −, PD + faint orange.

Parmelia sulcata Tayl.

Inverness Co.: Big Intervale, on *Betula*, coll. J. Macoun, July 15, 1898, as intermixture with *P. saxatilis*, under which it is recorded in Macoun, 1902, p. 68. Ster.—Craigmore, alt. 35 to 135 m.s.m., on metamorphic rock outcrops on hillside, often abundant, coll. I.M.L., June 12 and 16, 1952 (Nos. 6605, 6684). Ster.—Same locality, alt. *circ.* 85 m.s.m., on trunk of *Picea* in open hillside woods, coll. I.M.L., June 12, 1952 (No. 6599). Ster.

Victoria Co.: Baddeck, coll. J. Macoun, July 9, 1898, distributed—mixed with *P. saxatilis* var. *divaricata*—in Macoun's Canad. Lich. No. 41 ("*P. saxatilis*"). Ster. (Only "Cape Breton Island" given on the label, but the date indicates that it was collected at or near Baddeck.)

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on piles of stones near the seashore, on site of the fortifications, associated with *P. saxatilis*, *Lecidea albidocinerella*, and *Candelariella vitellina*, coll. I.M.L., July 19, 1952 (Nos. 6896 pr. p., 6903 pr. p.). Ster.—Mainadieu, common on cliffs along the seashore 5 to 10 m. above the sea, coll. I.M.L., July 23, 1952 (No. 6924). Ster.

The specimens from Louisburg belong to the f. *munda* (Oliv.) Oliv.

Cetraria (Eucetraria) **crispa** (Ach.) Nyl.

F. **minor** (Grogn.) M. Lamb, **n. comb.** (Syn. *C. islandica* var. *crispa* f. *minor* Grogn., Pl. Crypt. Cellul., 1863, p. 55; *C. tenuifolia* f. *minor* Hillmann, 1936, p. 302).

Inverness Co.: Half Way House, on earth, "very rare", coll. J. Macoun, Aug. 6, 1898 Macoun, 1902, p. 54, *s.n. C. islandica* var. *crispa*). Ster.

A small, low, compact plant, revised by H. Howe, Jr. already in 1915 as *C. tenuifolia* f. *minor*. Medulla PD−.

Cetraria islandica (L.) Ach.

Inverness Co.: MacGregor Mountain above Cabot Trail, alt. 1,500 feet, among mosses and *Cladoniæ* in a bog, coll. J. S. Erskine, Aug. 7, 1951 (No. 50 C 1533). Ster.

Plentiful and well developed material. It belongs to the European chemical strain of the species, with medulla PD + yellow then miniate-red; cf. Asahina, 1934, pp. 51-52, and Hillmann, 1936, p. 304.

According to Nichols, 1918, p. 400, *C. islandica* is one of the characteristic species of the upper barrens.

Cetraria nivalis (L.) Ach.

Victoria Co.: Ingonish Barrens, on rocky outcrops, coll. J. S. Erskine, July 23, 1952 (No. 52 C 1939). Ster.

Abundant material.

Cetraria (Platysma) **glauca** (L.) Ach.

Inverness Co.: Big Intervale, on trees in woods, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 57). Ster.—Craigmore, alt. *circ.* 200 m.s.m., on standing trunk of dead *Abies* beside trail through mixed woods, coll. I.M.L., June 16, 1952 (No. 6680). Ster.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on trunk of old *Betula* by roadside, associated with *Parmelia physodes* f. *vittatoides*, coll. I.M.L., June 22, 1952 (No. 6719 pr. p.). Ster.—Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on exposed granitic and metamorphic blocks on open hillside, coll. I.M.L., July 5, 1952 (No. 6835). Ster.

Victoria Co.: Baddeck, on trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 57). Ster.—Cape North near Bay St. Lawrence, alt. *circ.* 330 m.s.m., on trunk of *Betula* in open mixed woods, coll. I.M.L., Aug. 3, 1952 (No. 6969). Ster.

Cape Breton Co.: Louisburg, on rocks, coll. J. Macoun, Aug. 18, 1898 (Macoun, 1902, p. 57). Ster.

Macoun's specimen from Louisburg belongs to the f. *fusca* Flot. Macoun, loc. cit., also mentions this species from Inverness Co., Half Way Brook, but there is no specimen in the National Herbarium.

The writer was surprised to find no representative of the *Cetraria lacunosa*-group (*C. atlantica* (Tuck.) DR. or *C. norvegica* (Lynge) DR.) in Cape Breton, because, in Maine, Degelius found *C. atlantica* to be much more common than *C. glauca* (Degelius, 1940, pp. 49, 50).

Cetraria hepatizon (Ach.) Vain.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 300 m.s.m., on granite rock at side of trail through mixed woods, coll. I.M.L., Aug. 6, 1952 (No. 6994). Fert.—About 8 miles up the Clyburn valley from Ingonish, alt. *circ.* 420 m.s.m., on rock face in wooded gorge of the stream, near a waterfall, coll. I.M.L., Aug. 9, 1952 (No. 7009). Fert.—Cape North near Bay St. Lawrence, alt. *circ.* 235 m.s.m., on rocks and boulders of talus slope on mountainside, abundant, coll. I.M.L., Aug. 3, 1952 (No. 6983). Fert.

Cetraria pinastri (Scop.) Röhl.

Inverness Co.: Big Intervale, on old fences and stumps, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 58, *s.n. C. juniperina* var. *Pinastri*). Ster.—Upper Margaree River, on dead wood, coll. J. S. Erskine, July 5, 1952 (No. 52 C 2068). Ster.

Victoria Co.: Franey Mountain trail near Ingonish, alt. *circ.* 135 m.s.m., on granite boulder beside trail through mixed woods, scarce, coll. I.M.L., Aug. 6, 1952 (No. 6996). Ster.—Black Brook (top of plateau), on *Picea*, coll. J. S. Erskine, Aug. 9, 1951 (No. 50 C 1551). Ster.

Cornicularia aculeata (Schreb.) Ach.

Victoria Co.: Mary Ann Brook Fire Trail, on barren soil, associated with *Cladonia pleurota* f. *frondescens*, coll. J. S. Erskine, Aug. 8, 1950 (No. 50 C 1540 pr. p.). Ster.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on exposed heathy ground among stones and in crevices between rocks on site of the fortifications near the seashore, coll. I.M.L., July 19, 1952 (Nos. 6881, 6885). Ster.

Nephromopsis ciliaris (Ach.) Hue

Inverness Co.: Big Intervale, on old fence rails, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 55, *s.n. Cetraria ciliaris*). Fert.—Half Way Brook, on tamarack twigs in a swamp, coll. J. Macoun, Aug. 6, 1898 (Macoun, 1902, p. 55, *s.n. Cetraria ciliaris*). Fert.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on dead twigs and branches of *Abies* at edge of woods, scarce, coll. I.M.L., June 23, 1952 (No. 6745). Fert.

Victoria Co.: Eight miles northwest of Baddeck, alt. *circ.* 100 m.s.m., on dead lower twigs of spruce trees near the road, coll. I.M.L., July 14, 1952 (No. 6853). Fert.

Also recorded by Macoun, loc. cit., as *Cetraria ciliaris*, from Victoria Co., Baddeck, and Cape Breton Co., Louisburg, but no corresponding specimens are now present in the National Herbarium.

USNEACEAE

Evernia mesomorpha Nyl.

Inverness Co.: Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on dead branch of *Picea*, coll. I.M.L., June 25, 1952 (No. 6753). Ster.

Apparently scarce here; only one small tuft seen.

Alectoria (Bryopogon) **jubata** (L.) Ach.

Var. **lanestris** Ach. *emend.* DR.

Inverness Co.: Craigmore, alt. *circ.* 165 m.s.m., on dead twigs of *Abies* in open coniferous woods, coll. I.M.L., June 16, 1952 (No. 6686). Ster.

Victoria Co.: Baddeck, on spruce and fir trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 63, *s.n. Bryopogon jubata* var. *implexa*). Ster.—Plaister Mines near Baddeck, alt. *circ.* 35 m.s.m., on dead branches of *Picea* by the roadside, coll. I.M.L., July 17, 1952 (No. 6873). Ster.

[Var. *prolixa* Ach.

"*Bryopogon jubata* var. *prolixa*" is recorded by Macoun, 1902, p. 63, from Victoria Co., Baddeck, coll. J. Macoun, 1898, but no specimen of this collection is present in the National Herbarium.]

Alectoria nidulifera Norrl.

Victoria Co.: Baddeck, on spruce trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 63, *s.n. Bryopogon jubata* var. *chalybeiformis*). Ster.

Macoun, loc. cit., cites "*Bryopogon jubata* var. *chalybeiformis*" also from Inverness Co., Big Intervale, and Half Way Brook, but the above specimen from Baddeck is the only one from Cape Breton under that name in the National Herbarium.

A. nidulifera occurs also in the island of Miquelon (Arnold, 1888, p. 82). Du Rietz, 1924a, p. 50, records it from as far south as North Carolina in the United States, so that it is probably rather widely distributed in North America. In the National Herbarium there is a specimen from Yarmouth, in southern Nova Scotia, coll. J. Macoun, 1910, correctly determined as *A. nidulifera* by Merrill.

Alectoria (Eualectoria) **sarmentosa** (Ach.) Ach.

Victoria Co.: Baddeck, on spruce trees, coll. J. Macoun, July 29, 1898 (Macoun, 1902, p. 64). Ster.

Ramalina dilacerata (Hoffm.) Vain.

Inverness Co.: Big Intervale, on dead spruce trees, abundant, coll. J. Macoun, July 18, 1898 (Macoun, 1902, p. 50, *s.n. R. minuscula*). Fert.; with some admixture of *R. roesleri*. Also distributed from Cape Breton Island, without exact locality, in Macoun's Canad. Lich. No. 3, as *R. minuscula*.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on dead twigs of an old spruce tree by the roadside, sparingly as admixture with *R. farinacea* and *R. roesleri*, coll. I.M.L., June 25, 1952 (No. 6755a). Fert.

Ramalina farinacea (L.) Ach.

Inverness Co.: Big Intervale, on trees in woods, coll. J. Macoun, July 18, 1898 (Macoun, 1902, p. 50, *s.n. R. calicaris* var. *farinacea*). Ster.—Craigmore, alt. *circ.* 85 m.s.m., on trunks and branches of *Picea* in open hillside woods, coll. I.M.L., June 12, 1952 (No. 6601). Ster.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on trunks and dead twigs of *Picea* by the roadside, associated with *R. roesleri*, coll. I.M.L., June 22 and 25, 1952 (Nos. 6729 pr. p., 6755). The latter sparingly fert.—Same locality, on sloping face of a limestone. outcrop at bank of river, very scarce, coll. I.M.L., June 22, 1952 (No. 6728). Ster.

Victoria Co.: Baddeck, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 50, *s.n. R. calicaris* var. *farinacea*). Ster.—Ingonish, Middle Head, alt. *circ.* 25 m.s.m., on dead twigs and branches of spruce tree on exposed headland, coll. I.M.L., July 29, 1952 (No. 6943). Ster.—Aspy Bay, South Pond, on soil, coll. J. S. Erskine, July 13, 1952 (No. 52 C 2053). Ster.

Cape Breton Co.: Grand Narrows, on spruce trees in woods, coll. J. Macoun, July 26, 1898 (Macoun, 1902, p. 50, *s.n. R. calicaris* var. *farinacea*). Ster.—Mainadieu, alt. *circ.* 10 m.s.m., on branches of windswept spruce trees at the shore, associated with *R. roesleri*, coll. I.M.L., July 23, 1952 (Nos. 6927 pr. p., 6928a). Ster.

Mentioned by Macoun, loc. cit., as *R. calicaris* var. *farinacea*, also from Louisburg, on rocks, but no corresponding specimen is now present in the National Herbarium.

All the specimens have the medulla and soredia KHO — or sordid yellowish or brownish (not red), PD + faintly to strongly orange-red, except in the two specimens from Mainadieu, which are PD−. This indicates phases of the typical or Protocetraric acid chemical strain of the species (cf. Asahina, 1938, p. 658). The typical strain occurs on bark, only rarely on rock or on soil, whereas the Salazinic acid (?) or "angustissima"-strain (Syn. *R. farinacea* var. *angustissima* Anzi, *R. subfarinacea* Nyl.) appears to be restricted to rocks; cf. Degelius, 1939, pp. 180-181.

Ramalina fastigiata (Pers.) Ach.

Inverness Co.: Big Intervale, on trees in woods, rare, coll. J. Macoun, July 18, 1898 (Macoun, 1902, p. 49, *s.n. R. calicaris* var. *fraxinea*). Fert.

The specimen had been redetermined by Heber Howe as *R. fastigiata* already in 1914. It more or less agrees in habitus with the photograph of Persoon's N. American type-specimen reproduced on Pl. II, fig. 2, in Howe, 1914. Spores straight, 10·0 to 13·5 x 4 to 5 μ. Some of the laciniæ and apothecial receptacles have distinct small white pseudocyphellæ; Degelius, 1941, p. 68, mentions similar pseudocyphellæ in an undetermined *Ramalina* of the *fastigiata*-group from the United States, Tennessee. It would be interesting to compare these plants with *R. calicaris* var. *punctata* Räs. in Ann. Bot. Soc. Fenn. Vanamo, XX (1944), p. 5, described from Japan.

Ramalina roesleri (Hochst.) Hue

Inverness Co.: Big Intervale, on trees in woods, coll. J. Macoun, July 14, 1898 (Macoun, 1902, p. 51, *s.n. R. polymorpha*). Ster.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on trunks and dead twigs of *Picea* by the roadside, associated with *R. farinacea*, coll. I.M.L., June 22 and 25, 1952 (Nos. 6729 pr. p., 6756). Ster.

Victoria Co.: Baddeck, on dead spruce trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 51, *s.n. R. polymorpha*). Sparingly fert.

Cape Breton Co.: Louisburg, on trees, coll. J. Macoun, no date given (Macoun, 1902, p. 51, *s.n. R. polymorpha*). Ster.—Same locality, alt. *circ.* 5 m.s.m., between stones on the site of the fortifications, exposed position, coll. I.M.L., July 19, 1952 (No. 6887). Ster.—Mainadieu, alt. *circ.* 10 m.s.m., on branches of windswept spruce trees at the shore, associated with *R. farinacea* and *Xanthoria polycarpa*, coll. I.M.L., July 23, 1952 (Nos. 6927 pr. p., 6928, 6929 pr. p.). Ster.

Characteristically occurs on dead spruce twigs (cf. Ahlner, 1948, pp. 78-84), but also occasionally on rocks.

[*Usnea comosa* (Ach.) Röhl.

This species was identified by Dr. Motyka as an admixture in the duplicates sent of the writer's specimens of *U. dasypoga* and *U. fibrillosa* from Inverness Co., Margaree Forks (No. 6718) and Victoria Co., Plaister Mines

(No. 6874) respectively, but in the material retained it cannot be found in either of these specimens. It appears to be common in Canada, having been recorded by Motyka, 1936-47, from localities in Quebec, New Brunswick, Newfoundland, British Columbia, and Yukon Territory, and is given in Macoun's Canad. Lich. No. 14 as "*Usnea barbata* var. *hirta*" from Quebec, Gaspé Peninsula, at least pr. p. (mixed in some examples with *U. dasypoga* subsp. *melanopoga*, acc. to Motyka, op. cit.).]

Usnea dasypoga (Ach.) Röhl. emend. Mot.

Inverness Co.: Craigmore, alt. *circ.* 100 m.s.m., on branches of dead *Picea* in mixed woods, coll. I.M.L., June 13, 1952 (No. 6641). Ster.—Vicinity of Margaree Forks, alt. *circ.* 65 m.s.m., on trunk of old *Betula* by the roadside, coll. I.M.L., June 22, 1952 (No. 6718). Ster.

Victoria Co.: Baddeck, on trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 61, *s.n. U. barbata* var. *ceratina*). Ster.

Usnea fibrillosa Mot.

Victoria Co.: Plaister Mines near Baddeck, alt. *circ.* 35 m.s.m., on dead twigs and branches of *Picea* by the roadside, coll. I.M.L., July 17, 1952 (No. 6874). Ster.

New to Canada. Det. J. Motyka. This species strongly resembles *U. dasypoga* and according to Motyka, 1936-47, p. 189, could be regarded as a subspecies of the latter. It differs in the thinly capillaceous thallus with scanty or completely lacking lateral divaricate branchlets. The colour of the thallus in the European specimens described by Motyka, loc. cit., is stated to be "griseo aut sat pallide viridis"; in the writer's specimen it has a distinctly yellowish, greenish-stramineous tinge.

Usnea longissima Ach.

Victoria Co.: Baddeck, on trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 62). Ster.

Another identical specimen, also sterile, from the same locality and collected on the same day, was distributed as No. 27 of Macoun's Canad. Lich. Motyka, 1936-47, p. 429, lists this number as from Halifax in southern Nova Scotia, coll. Macoun in 1883, and so it is obvious that heterogeneous material was distributed, as was so often the case with this series.

Usnea scabrata Nyl.

Victoria Co.: Baddeck, on trees, coll. J. Macoun, July 27, 1883 (Macoun, 1902, p. 61, *s.n. U. barbata* var. *plicata*). Ster.

New to Canada. The specimen agrees excellently in its characteristic habitus with Anzi, Lich. Ital. Super. No. 14 ("*Usnea barbata* var. *plicata*") which is typical *U. scabrata* according to Motyka, 1936-47, p. 146. It also agrees in the chemical reactions (medulla KHO at first — or indistinctly yellowish, then slowly rufescent or red, at any rate in places around the axis; PD + persistent orange-yellow).

This specimen seems to be the only lichen collected by Macoun on his earlier visit to Cape Breton in 1883. There is another specimen of "*Usnea barbata* var. *plicata*" mentioned by Macoun, loc. cit., from Inverness Co., Big Intervale, but it seems to be no longer present in the National Herbarium.

Usnea trichodea Ach. *emend.* Mot.

Victoria Co.: Baddeck, on fir trees, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 62). Ster.

An easily recognizable species on account of the smoothly terete thallus with numerous annular fractures. It was originally described from Nova Scotia (coll. Menzies).

CALOPLACACEAE

Caloplaca (Eucaloplaca) **aurantiaca** (Lightf.) Th. Fr.

Victoria Co.: Baddeck, on *Fraxinus* in a swamp, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 103, *s.n. Placodium ferrugineum* var. *discolor*). Fert.

The true *C. discolor* (Willey) Fink has not been found in Cape Breton, but in the National Herbarium there are two specimens of it collected by Macoun at Yarmouth in southern Nova Scotia in 1910, easily recognizable by the characteristic efflorescences of coarsely granular, ferruginous-yellow soredia.

Caloplaca flavovirescens (Wulf.) D.T. & Sarnth.

Inverness Co.: Cape Breton Highlands Park, between Cheticamp and Cap Rouge, alt. *circ.* 50 m.s.m., on large rock in partial shade of trees in a stream-gully, associated with *Lecanora* (*Aspicilia*) *cinerea*, coll. I.M.L., July 3, 1952 (No. 6830). Fert.

Caloplaca fraxinea M. Lamb (n. sp.).

Victoria Co.: Baddeck, on bark of black ash trees (*Fraxinus nigra*) in a swamp, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 103, *s.n. Placodium ferrugineum*). Fert.

Thallus late effusus, tenuissimus, submembranaceus, lævis, continuus aut interruptus aut partim deficiens, distincte pallide flavicans (KHO + purpurascens) aut pr. p. decoloratus et albescens (KHO non vel vix mutatus), opacus, esorediosus, hypothallo nullo distincto. Apothecia numerosa, sparsa, tota ferrugineo-rufa, 0·5 − 0·8 (−1·0) mm. lata, rotundata aut hinc inde leviter flexuoso-difformia, margine persistenti subconcolore tenui aut fere mediocri, integro vel rarius subflexuoso circumdata, disco plano aut interdum leviter convexulo, lævi, opaco, nudo. Apothecia subbiatorina, gonidia nulla aut parcissima continentia; hypothecium incolor, grumoso-oleosum; hymenium 75 − 85 μ altum, superne obscure flavido-inspersum (KHO + purpureum), cæterum hyalinum, saltem parte infera bene oleosoinspersum. Paraphyses discretæ, haud articulatæ, 1·5 − 2·5 μ crassæ, apicibus parum incrassatæ. Sporæ 4 − 8næ, ellipsoideæ aut late ellipsoideæ, polari-biloculares, 15 − 18 x *8 − 9 (−10) μ, septo incrassato (5 − 8 μ) et plerumque tubulo tenui perforato. —Thallo flavescenti ut in* C. aurantiaca *(Lightf.) Th. Fr. sed apotheciis ferrugineis ut in* C. ferruginea *(Huds.) Th. Fr. locum quasi intermedium inter has species tenet. Inter species americanas potissime* C. arizonicæ *H. Magn. et* C. atrosanguineæ *(Merr.) M. Lamb relata.*

Thallus effuse, widespread, very thin, ± membranaceous, smooth, continuous or in places interrupted or ± evanescent, in the thicker parts of a distinct pale yellow colour (KHO + purpurascent), the thinner parts whitish, KHO − or nearly so; matt, without isidia or soredia. No distinct hypothallus. Apothecia numerous, scattered, rarely 2 to 3 concrescent, 0·5 to 0·8 (−1·0) mm. diam., ferruginous-reddish (as in *C. ferruginea*), round or sometimes slightly flexuose-difform, with persistent, thin or moderate, entire or occasionally subflexuose margin concolorous with the disk or slightly paler; disk plane or sometimes finally slightly convex, matt, smooth, naked.

Apothecia ± biatorine in section, without algæ or with only a few small scattered groups in the lower part below the hypothecium. Margin 45 to 55 μ thick, continued for some way below the apothecium but lacking at the centre, brownish-yellow-inspersed in outermost 8 to 14 μ (KHO + crimson-purple), the inner part colourless and hyaline, of radiating structure with conglutinated, parallel hyphæ 2·5 to 3·5 μ thick, not divided into cells. Hypothecium colourless, 90 to 110 μ deep in centre, the lower part slightly lax, the upper 50 to 70 μ compact and ± grumose with numerous small oil-droplets; composed of moderately thick-walled hyphæ 3 to 4 μ diam. interwoven in various directions, or in the upper part forming a ± cellulose tissue. Hymenium 75 to 85 μ high, densely inspersed in uppermost 10 to 17μ with brownish-yellow granules (KHO + crimson-purple), otherwise colourless, inspersed, at least in its lower half, with numerous small oil-droplets. Paraphyses discrete, 1·5 to 2·5 μ thick, simple or occasionally branched, not articulated, only slightly swollen (up to 3 μ) at the tips and there not distinctly moniliform. Asci clavate, 55 to 70 x 13 to 17 μ, with wall about 1 μ thick at sides and thickened up to 6·5 (−10) μ at apex. Spores 4 to 8 in ascus, subbiseriate, ellipsoid to broadly ellipsoid (not citriniform), equally rounded at ends, polaribilocular, 15 to 18 x 8 to 9 (−10) μ, the septum 5 to 8 μ thick, often pierced by a connecting tubule; the apical wall very thin.—Hymenium I + dark blue. Exciple I−, hypothecium I— or faintly blue in upper part.

The thallus is like that of *C. aurantiaca* (Lightf.) Th. Fr., but the apothecia are distinctly ferruginous as in *C. ferruginea* (Huds.) Th. Fr. Very occasionally the thallus of *C. ferruginea* may show a faint yellowish tinge, and a var. *subflavens* (Lamy) Oliv. of *C. ferruginea* has been described with whitish-yellow thallus almost like that of *C. aurantiaca* (cf. Magnusson, 1944, p. 28). But the hymenium of *C. ferruginea* lacks the small oil-droplets which are conspicuous in the present species. *C. herbidella* (Nyl.) H. Magn. resembles *C. fraxinea* in the presence of oil-droplets in hypothecium and hymenium, but has a coralloid-granulose thallus and thinner spore-septum. Among the North American species, *C. fraxinea* appears to come closest to *C. arizonica* H. Magn., 1944a, p. 69, but differs in the persistently plane and marginate apothecia, thicker spore-septum, etc. It also seems to approach *Caloplaca atrosanguinea* (Merr.) M. Lamb, **n. comb.** (Syn. *Lecanora atrosanguinea* Merrill in Ottawa Naturalist, XXVII, 1913, p. 117, omitted in Zahlbr. Cat. Lich. Univ.) from British Columbia, Vancouver Island, as far as can be judged from Merrill's description, but differs in the yellow thallus and the rounded ends of the spores.

Caloplaca pyracea (Ach.) Th. Fr.

Victoria Co.: Baddeck, on *Fraxinus*, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 102, *s.n. Placodium cerinum*). Fert.

Caloplaca vitellinula (Nyl.) Oliv.

F. **lignicola** (Nyl.) M. Lamb, **n. comb.** (Syn. *Lecanora aurantiaca* f. *lignicola* Nyl. Lich. Scand., 1861, p. 143; *Caloplaca aurantiaca* f. *lignicola* Th. Fr. Lich. Scandin., 1871, p. 178, *saltem pr. p.*).

Inverness Co.: Craigmore, alt. *circ.* 25 m.s.m., on wooden shingles of wall of an old barn, intermixed with *Lecanora hageni*, coll. I.M.L., June 19, 1952 (No. 6711 pr. p.). Fert.

Through the courtesy of the University Botanical Museum at Helsinki the writer received on loan the specimen which must be considered as the holotype of "*Lecanora aurantiaca* f. *lignicola*" Nyl., Herb. Nyl. No. 35206, from Stockholm ("Holmiæ"), coll. W. Nylander, 1852. In his original description in Lich. Scand. he gives only "Scandinavia" as locality. The following is a description of this specimen:

On lignum, forming effuse, extensive patches, without accompanying species. Thallus very reduced, distinctly yellow, filmy or in places verrucose-uneven, thin (similar to that of *C. aurantiaca*), KHO + crimson-purple. Apothecia very numerous, crowded and contiguous or ± scattered, (0·3–) 0·4 to 0·8 (–1·0) mm. diam., concave to plane, rarely becoming finally slightly convex, at first or for a long time with a distinct, prominent, moderate, ± entire thalline margin concolorous with the thallus or darker (orange), then finally (or sometimes soon) reflexed and evanescent. Disk orange-reddish (not ferruginous), smooth, matt, naked. Apothecia in section lecanorine, with algæ in margin and also forming a continuous layer below the hypothecium. Hypothecium 35 to 50 μ deep, colourless, not inspersed with oil-droplets. Hymenium 55 to 60 μ high, not inspersed with oil-droplets; epithecium dark yellow, granulose, KHO + crimson-purple. Paraphyses discrete, 1·5 to 2·5 μ thick, at tips capitate- or submoniliform-swollen up to 6 μ. Asci about 50 μ long. Spores ellipsoid, polaribilocular, 10·0 to 13·5 x 5 to 6 μ, the septum 3 to 4 μ thick.

The writer's Cape Breton specimen agrees well with the type described above, except that the apothecia are somewhat more crowded and sooner immarginate, and the hymenium is slightly higher (60 to 70 μ, with asci 50 to 60 μ long). The spores agree well in size and form (11 to 14 x 5·0 to 6·5 μ, with septum 3·5 to 5·0 μ thick).

It is obvious that this f. *lignicola* cannot belong to *C. aurantiaca*, which not only has larger spores, 13 to 20 (–24) x (6·5–) 8 to 12 (–14) μ, but also a higher hymenium, 70 to 100 μ high, inspersed in its lower half (like the hypothecium) with numerous small oil-droplets. In these characters it approaches better to *C. pyracea* (Ach.) Th. Fr., but cannot be brought under that species either on account of the distinctly yellow thallus (never yellow in *C. pyracea*). In the writer's opinion it is best placed under *C. vitellinula* (Nyl.) Oliv. (s. str.), which was based on a corticolous specimen ("ad alnos in Lapponia orientali") and originally described by Nylander in Flora, XLVI (1863), p. 305, in the following words: "Similis *pyraceæ*, sed apotheciis vitellinis (sæpius sat confertis) et thallo (obsoleto vel tenuissimo) subindeterminato vel vix determinato, flavescente (vitellino-flavescente). Sporæ longit. circiter 0,011 millim., crassit. 0,0045 – 0,0065 millim." The epithet *vitellinula* has subsequently become somewhat confused in its application, being later almost exclusively applied to saxicolous species, also by Nylander himself, e.g. in Lich. Japon. (1890), p. 39, and should probably be restricted to its original delimitation referring to corticolous plants only. Unfortunately I have not seen the type-specimen of the species, but the f. *lignicola* is certainly better brought under *C. vitellinula* than under *C. aurantiaca*. *C. vitellinula* has not been hitherto recorded from Canada.

Caloplaca (Gasparrinia) **elegans** (Link) Th. Fr.

Inverness Co.: Upper Salmon River, on metamorphic rocks of dry southward-facing cliff, coll. J. S. Erskine, July 9, 1952 (No. 52 C 2006). Fert.

Var. **discreta** (Schaer.) Zahlbr.

Cape Breton Co.: Louisburg, alt. *circ.* 5 m.s.m., on cliff face near the seashore, covering a large area, coll. I.M.L., July 19, 1952 (No. 6894). Sparingly fert.

Agrees well with Schaerer, Lich. Helv. Exs. No. 481 ("*Parmelia elegans* β *fulva* b.") in Farlow Herb., authentic material of the var. *discreta*, except in the somewhat paler orange-red colour in the present specimen. Laciniæ short, narrow, subdiscrete, non-stellate; apothecia minute, up to 0·3 mm. diam.

Var. **tenuis** (Wbg.) Th. Fr.

Cape Breton Co.: Mainadieu, on seashore cliffs about 5 m. above the sea, coll. I.M.L., July 23, 1952 (No. 6923). Sparingly fert.

Laciniæ very slender as in var. *discreta*, but longer and with distinct radiate-stellate arrangement.

Caloplaca cf. **marina** var. **flavogranulata** Wedd.

Cape Breton Co.: Mainadieu, on the shoreward side of marine rocks at the extreme point, about 3 m. above the sea, in the lower hygrohaline, associated with *Lecanora*-sp., coll. I.M.L., July 23, 1952 (No. 6918 pr. p., 6921). Fert.

It agrees with Weddell's original description in Mém. Soc. Sci. Nat. Cherbourg, XIX (1875), p. 275, of the type from France, Ile de Yeu: "Thallus subeffusus, flavicans v. sordide citrinus, undique granulato-verucosus et sæpissime inter verrucas nigro-conspurcatus. Apothecia sparsa, figura et colore ut in typo aut margine in vetustioribus extus granulis crenisve citrinis aucto"; but unfortunately the writer has been unable to see any of Weddell's material for comparison. It seems to be a proper species, distinct from *C. marina* and belonging to the sect. *Eucaloplaca*, for the verruculose-granulate thallus shows no trace of marginal effiguration. *Caloplaca salina* Erichs. in Ann. Mycol. XXXVIII (1940), p. 325, described from littoral rocks on the North Sea coast of Germany, seems from the description to be very similar, but has ± developed marginal laciniæ.

Caloplaca scopularis (Nyl.) Lett.

Victoria Co.: Ingonish, Middle Head, on marine rocks in the storm-spray-zone about 5 m. above the sea (nitrogenous position, frequented by seagulls), coll. I.M.L., July 29, 1952 (No. 6950). Fert.

TELOSCHISTACEAE

Xanthoria parietina (L.) Beltr.

Inverness Co.: Craigmore, alt. *circ.* 65 m.s.m., on trunk of *Salix* in hillside field, associated with *Physcia orbicularis* f. *rubropulchra*, coll. I.M.L., June 12, 1952 (No. 6609). Fert.

Xanthoria polycarpa (Ehrh.) Rieber

Inverness Co.: Big Intervale, Margaree, on old fence rails, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 66, *s.n. Theloschistes polycarpus*). Fert.

Cape Breton Co.: Mainadieu, alt. *circ.* 10 m.s.m., on branches of windswept spruce trees at the shore, associated with *Ramalina roesleri* and *R. farinacea*, coll. I.M.L., July 23, 1952 (No. 6929). Fert.

Also mentioned by Macoun, loc. cit., as *Theloschistes polycarpus*, from Cape Breton Co., Grand Narrows, on spruce twigs, but this specimen is not present in the National Herbarium.

The writer's specimen from Mainadieu has very narrow, terete-subcoralloid, richly branched laciniæ, and is perhaps referable to the var. *angusta* B. de Lesd., 1941, p. 63, of which no material has been seen for comparison.

Var. **maritima** M. Lamb (n. var.)

Victoria Co.: Ingonish, Middle Head, alt. *circ.* 25 m.s.m., on granite rocks on exposed grassy headland, a nitrogenous position frequented by seagulls and terns, coll. I.M.L., July 29, 1952 (No. 6952, type-specimen). Fert.—McNeil's Harbour, on "fish flakes"*, coll. J. Macoun, Aug. 4, 1898 (Macoun, 1902, p. 66, *s.n. Theloschistes polycarpus*). Fert.

Pulvinuli thallini vitellini late confluentes et crustam fere continuam ad 8 centim. latum aut ultra, ad 3 mm. crassam efficientes, apotheciis aurantiacis 0·8 – 2·0 mm. latis, evolutis contiguis et pro maj. p. mutua pressione difformibus creberrime obtecti.

Description of the type-specimen: thalline pulvinuli confluent to form extensive, ± continuous patches up to 8 cm. or more across, up to 3 mm. thick, almost entirely covered by the crowded apothecia. Thallus vitelline or orange, vitelline (normal colour for the species), KHO + intense dark purple, matt, the peripheral lobes visible only here and there, crowded and imbricated, small, short, 0·5 to 0·8 (−1·0) mm. long, thick, tumid, ± free from the substratum, divided and crenulate, similar to those of the typical species. Apothecia very numerous and crowded, ± difform by mutual pressure, 0·8 to 2·0 mm. diam., with prominent, smooth or usually slightly rugose-crenulate thalline margin and concave to plane, smooth, matt, orange-coloured disk (KHO + dark purple).

Thallus lobes corticate on both sides, the upper cortex yellow-inspersed (KHO + crimson-purple), the lower cortex ± colourless, 13 to 17 μ thick. Medulla ± laxly hyphose, the hyphæ intricated in various directions. Symbiotic algæ bright green, globose, separate, large, 10 to 23 μ diam. Apoth. margin corticate, containing abundant algæ. Hymenium 60 to 70 μ high, densely yellow-inspersed in uppermost 9 to 12 μ (KHO + crimson-purple), otherwise colourless and hyaline. Spores ellipsoid, polaribilocular, 10 to 13 x 5 to 7 μ, with septum 4 to 5 (−7) μ thick, with or without connecting tubule.

Macoun's specimen on lignum is very similar, but with many of the apothecia small, verrucose, and unexpanded.

Possibly only an extreme overnourished condition of the species growing in highly nitrogenous positions, but seems sufficiently distinct in habitus to deserve varietal status.

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* Wooden frames erected near the seashore for drying fish.

BUELLIACEAE

Buellia parasema (Ach.) De Not. (Syn. *B. disciformis* (Fr.) Mudd)

Victoria Co.: Baddeck, on bark of *Acer*, and of *Alnus* and *Betula*, one specimen associated with *Bacidia chlorantha*, coll. J. Macoun, July 8, 1898 (Macoun, 1902, p. 162). Fert.—Hunter's Mountain near Baddeck, alt. *circ.* 165 m.s.m., on trunk of *Acer* at side of trail through mixed woods, coll. I.M.L., July 14, 1952 (No. 6864). Fert.

Buellia punctata (Hoffm.) Mass.

Inverness Co.: Margaree, on old fence rails, coll. J. Macoun, July 14, 1898 (Macoun, 1902, p. 163, *s.n. B. myriocarpa*). Fert.

Victoria Co.: Franey Mountain Trail near Ingonish, alt. *circ.* 135 m.s.m., on trunk of *Acer* beside trail through mixed woods, associated with *Parmelia subaurifera* and *Lecanora symmicta*, coll. I.M.L., Aug. 6, 1952 (No. 6997 pr. p.). Fert.

Buellia schaereri De Not.

Inverness Co.: Big Intervale, Margaree, on dead wood, coll. J. Macoun, July 16, 1898 (Macoun, 1902, p. 143, *s.n. Biatora viridescens*). Fert.

Buellia stillingiana Stnr. (*Lapsu "stillingiæ"* in Zahlbr. Cat. Lich. Univ. VII, 1931, p. 415).

Victoria Co.: Baddeck, on bark of *Fagus*, associated with *Parmelia subquercifolia*, coll. J. Macoun, July 9, 1898. Fert.

New to Canada. Dr. H. A. Imshaug, who is revising the North American species of *Buellia*, finds this species to be rather common in the Northeastern United States and in Eastern Canada, where it has been previously largely confused with *B. parasema*. It differs from the latter species chiefly in the absence of oil-droplets in the hymenium and in the paler, light brown or olivaceous inner part of the exciple, which forms a pale stratum below the dark brown hypothecium. Its chemical reactions are somewhat variable; typically the thallus is KHO + yellow then red, but the red colour often appears only in spots, and in many specimens only a persistent yellow colour is produced. The PD reaction is negative or sometimes faint orange-yellow. The species was originally described by Steiner in Oesterr. Bot. Zeitschr. LXVIII (1919), p. 144, from United States, Tennessee, on bark of *Stillingia*, coll. Calkins.

Rinodina cf. **annulata** H. Magn.

Victoria Co.: Baddeck, on *Fraxinus*, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 107, *s.n. Lecanora subfusca* var. *coilocarpa*). Fert.

On microscopic examination the specimen proved to be a *Rinodina* of the *exigua*-group with minute apothecia, strongly resembling a *Lecanora* of the *subfusca-glabrata*-series. It seems to agree with the description of *Rinodina annulata* H. Magn. in Bot. Notiser, 1947, p. 45, from U.S.A., New England, but the writer has seen no material of the latter species for direct comparison. It very much resembles *R. subfusca* H. Magn. (in Medd. Göteborgs Bot. Trädg. XVII, 1947, p. 240), according to a syntype-specimen from Siberia, Jenisejsk, Tolstoj Nos, coll. Brenner, 1876 (No. 431e) seen in the Farlow Herbarium, but differs anatomically in the poorly developed or absent cortex of the apothecial margin which is not brown in its outer part, and also in the shallower and not distinctly cellulose hypothecium.

PHYSCIACEAE

Pyxine sorediata (Ach.) Mont.

Victoria Co.: Baddeck, on tree trunks, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 78). Ster.

Physcia aipolia (Ehrh. ?) Hampe

Inverness Co.: Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on trunk of *Ulmus* at side of a field, coll. I.M.L., June 23, 1952 (No. 6741). Fert.

Physcia ascendens Bitt.

Inverness Co.: Big Intervale, Margaree, on old fence rails, coll. J. Macoun, July 22, 1898 (Macoun, 1902, p. 76, *s.n. Ph. hispida*). Ster.—Craigmore, alt. *circ.* 65 m.s.m., on trunk of *Salix* in hillside field, as intermixture with *Ph. orbicularis* f. *rubropulchra*, coll. I.M.L., June 12, 1952 (No. 6610 pr. p.). Ster.—Vicinity of Margaree Forks, alt. *circ.* 35 m.s.m., on trunk of *Ulmus* by the roadside, associated with *Parmelia rudecta*, coll. I.M.L., June 25, 1952 (No. 6760). Ster.

New to Canada.

Physcia dubia (Hoffm.) Lett. *emend.* Lynge

Inverness Co.: Craigmore, alt. *circ.* 150 m.s.m., on rock outcrop in hillside pasture, coll. I.M.L., June 15, 1952 (No. 6659). Ster.

Lower cortex of intertexted, gelatinous hyphæ. This is one of the characters that distinguishes *Ph. dubia* from the similar *Ph. tribacia* (Ach.) Nyl., in which the lower cortex is paraplectenchymatic; cf. Lynge, 1935, pp. 110-112, Pl. II, figs. 1 and 2.

Physcia orbicularis (Neck.) DR.

F. **rubropulchra** Degel., 1940, p. 58.

Inverness Co.: Craigmore, alt. *circ.* 65 m.s.m., on trunk of *Salix* in hillside field, associated with *Xanthoria parietina* and *Physcia ascendens*, coll. I.M.L., June 12, 1952 (No. 6610). Fert.—Same locality, alt. *circ.* 135 m.s.m., on trunk of *Fagus* in mixed woods, coll. I.M.L., June 15, 1952 (No. 6665). Fert.

Victoria Co.: Baddeck, on trees, rare, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 77, *s.n. Ph. obscura*). Ster.

Medulla bright orange- or miniate-red, KHO + very dark violet. Soredia greenish-whitish. Described from U.S.A., Maine, Prince's Point, on *Fagus* and *Juglans*, by Degelius. J. W. Thomson, Lich. Wisconsinens. Exs. No. 21 (*s.n. Physcia orbicularis*) from U.S.A., Wisconsin, Marathon Co., on *Ulmus*, seems also to belong to this form, as far as can be judged from the scanty material available.

Physcia stellaris (L.) Nyl. *emend.* Harm.

Victoria Co.: Baddeck, on trees in woods, coll. J. Macoun, July 9, 1898 (Macoun, 1902, p. 75). Fert.

Recorded also by Macoun, loc. cit., from Inverness Co., Big Intervale, but no specimen from there is now present in the National Herbarium.

Anaptychia ciliaris (L.) Körb.

Cape Breton Co.: Louisburg, on rocks, coll. J. Macoun, July 17, 1898 (Macoun, 1902, p. 74, *s.n. Physcia ciliaris* var. *crinalis*). Fert.—Mainadieu, on top of seashore cliffs about 5 m. above the sea, coll. I.M.L., July 23, 1952 (No. 6925). Ster.

Both specimens belong to the f. *solenaria* (Duby) Arn., forming mats of very narrow laciniæ, somewhat variegated in colour, whitish-grey to fuscous, glabrous. At Mainadieu it was growing in channels and crevices of the rock, where presumably it obtained more nitrogenous moisture.

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